United States Air Force
611th Air Support Group/
Civil Engineering Squadron

Elmendorf AFB, Alaska

Final

Remedial Investigation and Feasibility Study

Oliktok Point Radar Installation,
Alaska

(Volume 1 of 2 Includes Appendices A - B)

15 APRIL 1996

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Prepared by:

ICF Technology Incorporated

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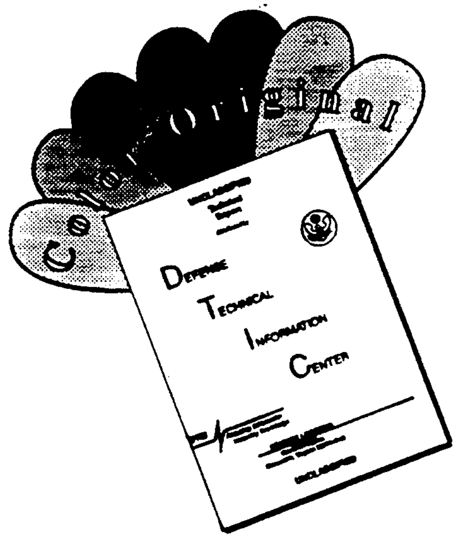

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PREFACE

This report presents the findings of Remedial Investigations and Feasibility Studies at sites located at the Oliktok Point radar installation in northern Alaska. The sites were characterized based on sampling and analyses conducted during Remedial Investigation activities performed during August and September 1993. This report was prepared by ICF Technology Incorporated.

This report was prepared between January 1995 and April 1996. Mr. Samer Karmi of the Air Force Center for Environmental Excellence was the Alaska Restoration Team Chief for this task. Dr. Jerome Madden and Mr. Richard Borsetti of the 611th CES/CEVR were the Remedial Project Managers for the project.

Approved:

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Thomas McKinney
Program Director
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NOTICE

This report has been prepared for the United States Air Force (Air Force) by ICF Technology Incorporated for the purpose of aiding in the implementation of final remedial actions under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate. Acceptance does not mean that the United States Air Force adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

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EXECUTIVE SUMMARY

BACKGROUND

The United States Air Force (Air Force) has prepared this Remedial Investigation/Feasibility Study (RI/FS) report as part of the Installation Restoration Program (IRP) to present results of RI/FS activities at eight sites at the Oliktok Point radar installation. The IRP provides for investigating, quantifying, and remediating environmental contamination from past waste management activities at Air Force installations throughout the United States. The IRP is a four-phase program that approximates the remedial investigation (RI) and corrective action program used by the U.S. Environmental Protection Agency (EPA) for addressing contaminated sites that may pose a risk to human health or the environment.

The Air Force initiated IRP activities at the Oliktok Point radar installation in 1980 in response to the Department of Defense's (DOD's) commitment to identify past waste disposal sites and eliminate hazards to public health. The initial Phase I conducted by the Air Force concluded that past waste management activities at the installation may have resulted in adverse environmental impacts at one site (CH2M Hill 1981).

An Air Force contractor conducted Phase II, Stages 1 and 2 Confirmation/Quantification activities in 1986. Phase II, Stage 1 activities involved field investigations of specific sites that were identified in the Phase I Installation Assessment/Records Search activities. The Phase II, Stage 1 activities consisted of collecting a surface water sample at the Old Landfill (LF01) (previously the Old Dump Site, Northwest) at the Oliktok Point Installation (Dames and Moore 1986).

An Air Force contractor prepared a Technical Operations Plan for the Phase II, Stage 2 work in August 1986. The Phase II, Stage 2 activities involved field investigation of the Old Landfill (LF01) where two surface water samples were collected. Analytical results and other observations were recorded in the Phase II, Stage 2 Draft Report released in August 1987 (Dames and Moore 1987).

An Air Force contractor released the final Technical Support Document for Record of Decision, Oliktok Point Distant Early Warning (DEW) Line Site, in 1987 (Woodward-Clyde 1987). The Record of Decision, applicable to potential hazardous waste sites identified at the Oliktok Point installation, called for no further action with regard to investigation or cleanup, based on the assessment that there is no significant impact on human health or the environmental from suspected or confirmed past contamination at the installation.

Correspondence from Alaska Department of Environmental Conservation (ADEC) personnel to Air Force personnel in November 1991 disagreed with the no further action conclusion and stated that further investigation is needed and that corrective action appeared necessary because of improper waste disposal practices and other issues.

A private contractor prepared the Environmental Assessment for the North Warning System (Alaska) in January 1987 (Hart Crowser 1987). The report discussed the impacts of retrofitting with long range radar equipment at the Oliktok Point DEW Line facility.

The Air Force initiated RI/FS activities at the Oliktok Point radar installation in the summer of 1993. During the initial scoping activities, which included record searches, personnel interviews, and physical inspection of the installation, the Air Force and ADEC personnel concluded that eight sites warranted investigation under the IRP. This document is a detailed presentation of RI/FS activities and provides conclusions and recommendations for addressing environmental conditions at the eight Oliktok Point sites. Remedial actions are recommended for four of the sites, and remedial alternatives recommended for cleanup of these sites are evaluated in the FS section of this document. No further action is recommended for the remaining four sites.

INSTALLATION DESCRIPTION

The Oliktok Point radar installation is located at 70°30'N, 149°53'W on the north coast of Alaska (Figure 1-1, page 1-5). The 2,325-acre installation is situated on Oliktok Point, east of the Colville River (Figure 1-2, page 1-7).

Oliktok Point radar installation, also known as POW-2, was constructed as an auxiliary DEW Line station between 1954 and 1955. The station structures include one 25-module train, radome radar, warehouse, garage, fixed petroleum, oil, and lubricants (POL) tanks, pumphouse, radar antennas, hangar, and 4,020-foot gravel runway.

Temperatures at the Oliktok Point installation are generally low throughout the year. Absolute temperature minimum and maximum ranges between -58°F and 78°F, respectively (Hart Crowser 1987). Precipitation at Oliktok averages 4.9 inches per year including 27 inches of snowfall. Permafrost at the installation area is up to 1,300 feet thick. Due to the permafrost, polygonal surface patterns are abundant.

The installation is located in an area dominated by the influence of coastal and thaw lake processes, and situated at an elevation of about 25 feet above mean sea level (MSL). The hydrology of the installation is controlled by the relatively low topography and permafrost. Even with the low precipitation rates, the tundra is predominantly swampy.

The geology of the installation is similar to the regional geology. Tundra mat overlies organic-rich peaty horizons that contain silt, with the Barrow unit of the Gubik Formation underlying the organic mats. Soils in the Oliktok Point area are moderately frost susceptible because of the high percentage of fine-grained material (Selkregg 1975). Coal, oil, and gas deposits may be present in the area; significant oil exploration and production have been conducted east of the installation at Kaparuk and Prudoe Bay.

The vegetative habitat types at Oliktok Point support a variety of wildlife. Areas in the vicinity of the installation provide habitat important to birds, mammals, and fish.

PROJECT ACTIVITIES

The Air Force conducted RI/FS field activities at eight sites at the Oliktok Point radar installation during 1993. The objectives of the Oliktok Point RI/FS were to confirm the presence or absence of chemical contamination of the environment at the installation; define the extent and magnitude

of confirmed chemical releases; gather adequate data to determine the magnitude of potential risks to human health and the environment; and gather adequate data to identify and select the appropriate remedial actions for sites where apparent risks exceed acceptable limits.

The RI field activities were carried out in a three-phased approach. The three phases, installation presurvey, reconnaissance, and RI field activities, allowed contractor personnel to confirm the location of areas of environmental concern and identify sampling locations before conducting RI field activities. The sites investigated during the RI activities are:

- Old Landfill (LF01)
- Dump Site (LF02)
- Dock Storage Area (ST03)
- POL Storage (ST04)
- Diesel Spill (SS05)
- Gasoline Storage Area (ST08)
- Garage (SS10)
- Old Sewage Area Petroleum Spill (SS11)

The site locations are shown on Figure 1-3 (page 1-9).

The RI field activities were conducted from mid-August through early September of 1993. The RI was conducted in conjunction with RIs at seven other radar installations located throughout northern Alaska. Sixteen contractor employees were stationed in Alaska for the duration of the RI. Sampling activities at the Oliktok Point radar installation included collection of surface and subsurface soil samples with hand tools, and collection of surface water, sediment, and seep samples from drainages adjacent to potentially contaminated areas.

A total of 136 samples was collected during the 1993 RI activities at Oliktok Point. These included soil, sediment, and surface water samples collected from the eight sites as well as samples for quality assurance/quality control (QA/QC) and to establish background levels. A summary of the samples collected is presented in Table ES-1.

Analyses of samples collected during RI activities were conducted by a fixed laboratory in Anchorage, Alaska, and a temporary laboratory set up at Barrow, Alaska. Laboratory analyses conducted by the temporary laboratory were conducted on a quick turnaround basis. Analyses conducted in Anchorage, Alaska, included primarily standard turnaround but also a few quick turnaround analyses.

The Air Force conducted a risk assessment once the data had been validated and compiled. The purpose of the risk assessment was to evaluate the human and ecological health risks that may be associated with chemicals released to the environment at the sites investigated during the RI. The risk assessment characterizes the probability that measured concentrations of hazardous chemical substances will cause adverse effects in humans or the environment in the absence of remediation. The risk assessment will be used in conjunction with state and federal standards and/or guidance to determine if remediation (site cleanup) is necessary. The Oliktok Point Risk Assessment (U.S. Air Force 1996) was submitted under separate cover.

TABLE ES-1. SUMMARY OF REMEDIAL INVESTIGATION SAMPLING

SITE	MEDIUM	NUMBER OF ENVIRONMENTAL SAMPLES
Old Landfill (LF01)	Soil/Sediment	6
	Surface Water	3
Dump Site (LF02)	Soil/Sediment	5
	Surface Water	1
Dock Storage Area (ST03)	Soil/Sediment	4
	Surface Water	1
POL Storage (ST04)	Soil/Sediment	3
Diesel Spill (SS05)	Soil/Sediment	16
	Surface Water	2
Gasoline Storage Area (ST08)	Soil/Sediment	26
	Surface Water	3
Garage (SS10)	Soil/Sediment	14
	Surface Water	1
Old Sewage Area Petroleum Spill (SS11)	Soil/Sediment	14
	Surface Water	3
Background (BKGD)	Soil/Sediment	5
	Surface Water	2
Total Environmental Samples	Soil/Sediment	93
	Surface Water	16
QA/QC SAMPLES		
Ambient Condition Blanks	Water	2
Equipment Blanks	Water	5
Trip Blanks	Water	6
Replicates/Duplicates	Soil/Sediment	11
	Surface Water	1
Investigation Derived Waste (IDW)	Water	2
Total Samples	Soil/Sediment	104
	Surface Water	32

CHRONOLOGY OF ACTIVITIES

Project scoping documents were submitted between June and August 1993 for review by Air Force Center for Environmental Excellence (AFCEE) and regulatory agencies. These documents include the Work Plan, Sampling and Analysis Plan (SAP), Health and Safety Plan, and Community Relations Plan for seven DEW Line installations and Cape Lisburne. The installation presurvey and the reconnaissance trips were conducted in order to provide the information necessary to conduct the RI/FS activities. The presurvey was conducted in May 1993 by a small group of contractor employees accompanied by Air Force representatives.

The reconnaissance trip was completed in June 1993 by contractor employees, and AFCEE and ADEC representatives. RI field activities were conducted from mid-August through early September 1993. Sampling was conducted from the areas of least contamination to areas of increasing contamination. The sequence of sampling from least to most contaminated was based on previous sampling data, field screening, and visual observations. Field screening was used to assist in determining the areal extent of contamination and sampling locations. Where quick turnaround sample analyses indicated information gaps about the areal extent of contamination, or exposure point concentrations for potentially exposed populations were not defined, a second round of samples was collected and analyzed.

SUMMARY OF REMEDIAL INVESTIGATION/FEASIBILITY STUDY

The following paragraphs describe RI activities conducted at the eight sites that are the focus of this report and summarize the findings of the RI. Summaries of human health and ecological risks posed by chemicals detected at each site are included. The remedial alternatives are presented for the sites recommended for cleanup. The evaluation of remedial alternatives is presented in the Feasibility Study (FS), Section 5.0.

Old Landfill (LF01). The Old Landfill is the location of the old installation landfill that received all wastes generated by the station, other than those that were incinerated, from 1956 to approximately 1978 (Figure 3-1, page 3-9). The site was cleaned, covered, and reseeded between 1978 and 1980. It is located approximately one quarter mile west of the main installation. The site is less than one acre in size and is bordered on the west by a lagoon, to the south by tundra, and to the north by beach sand and gravels.

Sampling and analyses have determined that there is no significant contamination at the Old Landfill (LF01). Only relatively low levels of contaminants were detected. Their source is suspected to be previous waste disposal at the Old Landfill, which is no longer active.

There does not appear to be any significant migration of contaminants from the site based on the surface water and sediment samples collected in drainage pathways leading from the site.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. Even using the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action. Based on the RI sampling and analyses, risk assessment, and current

or future site uses, remedial action are not warranted at the site. No significant human health or ecological risks were identified at the site. Therefore, the Old Landfill is recommended for no further action.

Dump Site (LF02). This site is west of the main station and east of the Old Landfill (LF01) and the Dock Storage Area (ST03) (Figure 3-2, page 3-23). The three sites are all located west of the main installation and consist of gravel covered areas; the boundaries between the sites are not readily discernable. The Dump Site was active from the late 1970s to the 1980s. It is reported to have been cleaned up in 1987 (Dames and Moore 1987). Large debris was hauled to the new landfill because the Dump Site was being eroded by the Beaufort Sea.

Sampling and analyses have determined that the Dump Site (LF02) is not contaminated. Only a very low level of toluene in one soil sample and metals that were not at a level of concern were detected at the site. As no significant contaminants were detected at the site, there appears to be no potential for contaminant migration or risk to human health or ecological receptors. Based on the RI sampling and analyses and risk assessment, the Dump Site (LF02) is recommended for no further action.

Dock Storage Area (ST03). The Dock Storage Area is located west of the POL tanks, east of the Old Landfill (LF01), and west of the Dump Site (LF02) (Figure 3-3, page 3-45). The site is approximately one-half acre in size and consists of a gravel covered area. The site was used for storage of drummed liquids, and drums were removed from the site prior to 1987 (Woodward-Clyde 1987).

Sampling and analyses have determined that low levels of contaminants [primarily diesel range petroleum hydrocarbons (DRPH)] were detected at the Dock Storage Area (ST03). Only low levels of contaminants were detected in soil/sediment and surface water. The source, although unknown, is suspected to be migration from spills and/or leaks associated with the Old Sewage Area Petroleum Spill (SS11). It is also possible that isolated spills and/or leaks caused by previous drum storage activities at the site could be a source. The site is presently inactive, so there is no longer a contaminant source at the site. Analytical data indicate that migration of contaminants from the site is minimal.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. The potential hazards and risks are based on a future scenario in which the site surface water would be used as a sole-source drinking water supply. Even using the conservative future scenario, the potential risks at the site are not of a magnitude that normally requires remedial action.

Based on the RI sampling and analyses and the risk assessment, remedial actions are not warranted at the site. No significant human health or ecological risk was identified at the site. Therefore, the Dock Storage Area (ST03) site is recommended for no further action.

POL Storage (ST04). The POL Storage site is a gravel pad area located northeast of the hangar and south of the installation airstrip (Figure 3-4, page 3-59). The gravel pad is approximately 200 feet by 100 feet and adjoins the gravel road leading to the hangar. The storage pad has been

identified by previous IRP contractors as Site 19. Currently, a weather monitoring station is constructed on the site. Drummed POL products were reportedly stored at the site until 1987 (Woodward-Clyde 1988).

Sampling and analyses have determined that there is no significant contamination at the POL Storage (ST04) site. Only relatively low levels of contaminants were detected. Their source is suspected to be spills and/or leaks from previous drum storage activities. The POL Storage is presently used as a weather monitoring station; drums are no longer stored at the site.

There does not appear to be any significant migration of contaminants from the site based on the soil samples collected. In addition, there were no chemicals of concern (COCs) identified for soil/sediment in the human health risk assessment, and none of the COCs identified in the ecological risk assessment (ERA) were associated with significant risk estimates at the site. Therefore, risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses.

Based on the RI sampling and analyses, risk assessment, and current or future site uses, remedial actions are not warranted at the site. No significant human health or ecological risks were identified at the site. Therefore, the POL Storage (ST04) site is recommended for no further action.

Diesel Spill (SS05). The Diesel Spill area is on the east side of the hangar and has been referred to in previous IRP documents as Site 20 (Figure 4-1, page 4-9). It is the site of an approximately 300-gallon diesel fuel spill which occurred in 1978. The east side of the hangar area consists of gravel pad that slopes to the east to tundra.

Sampling and analyses have determined that the Diesel Spill (SS05) site is contaminated with petroleum compounds [DRPH and gasoline range petroleum hydrocarbons (GRPH)] and volatile organic compounds (VOCs) [including benzene, toluene, ethylbenzene, and xylenes (BTEX)] commonly associated with diesel fuel. The contaminated media at the site include a small portion of the gravel pad east of the hangar and the adjacent tundra northeast of the hangar. The source of contamination is suspected to be spills and/or leaks associated with overfilling of the diesel day tank located near the east wall of the hangar. Analytical data indicate that there is a potential for contaminant migration.

The risk assessment concluded that risks posed to human health or ecological receptors by site contaminants are minimal given current or future site uses. The risks and hazards are based on a conservative future scenario and are not of a magnitude that normally requires remedial action.

Levels of DRPH, GRPH, and BTEX (total) detected in site soil/sediment, however, exceed ADEC guidance cleanup levels and contaminants may be migrating in the surface water. Therefore, the site is being recommended for remedial action. The contaminated area at the site consists of approximately 237 cubic yards of gravel and 1,111 cubic yards of tundra. The remedial action alternative recommended for all media at the site is enhanced bioremediation. A complete description and evaluation of the remedial alternatives considered for this site are presented in the FS, Section 5.0.

Gasoline Storage Area (ST08). The Gasoline Storage Area consists of gravel pad and tundra areas located to the north and east of the Garage (SS10) (Figure 4-2, page 4-25). Two steel diesel storage tanks were formerly located north of the Garage on the west side of the gravel pad. Presently there is a gasoline storage tank on the gravel pad northeast of the Garage. The site is bordered on the north and east by tundra vegetation and ponds.

Sampling and analyses have determined that the Gasoline Storage Area (ST08) site is contaminated with petroleum hydrocarbons [DRPH, GRPH, and residual range petroleum hydrocarbons (RRPH)] and VOCs (including BTEX) that are components of diesel fuel. The significantly contaminated areas at the site include approximately 2,963 cubic yards of tundra located north and west of the gravel pad adjacent to the Garage (SS10) site. Significantly contaminated gravel at the Gasoline Storage Area has been combined with the contaminated gravel at the adjacent Garage site for the purposes of remediation and is discussed in Sections 4.3 and 5.0. Analytical results indicate the highest petroleum concentrations were in the drainage pathways leading from the site. The suspected source of contamination is previous spills and/or leaks associated with previous gasoline storage activities conducted at the site.

The risk assessment concluded that risks posed to human health and ecological receptors are minimal given current site uses. The risk is not of a magnitude that normally requires remedial action. The ERA concluded that the overall potential risks presented by site contaminants are minimal. Levels of petroleum compounds (DRPH, GRPH, RRPH, and BTEX), however, detected at the site significantly exceed ADEC guidance cleanup levels and migration of contaminants has occurred. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is recommended.

The remedial action alternative recommended for the tundra at the site is enhanced bioremediation. A complete description and evaluation of the remedial alternatives recommended for this site are presented in the FS, Section 5.0.

Garage (SS10). The Garage site is located approximately 200 feet east of the module train. The Garage is an approximately 90-foot by 40-foot building elevated about four feet above the tundra and is surrounded on the north, east, and south sites by gravel pad (Figure 4-3, page 4-53). The building is used for vehicle maintenance and storage. The floor drains in this building previously discharged to pathways leading directly to the tundra. The drains were sealed by the Air Force in July 1993 to prevent future release of contaminants to the tundra.

Sampling and analyses have determined that the Garage (SS10) site is contaminated with petroleum hydrocarbons (DRPH, GRPH, and RRPH), VOCs (including BTEX) and semi-volatile organic compounds (SVOCs) that are primarily associated with gasoline and diesel fuels, a solvent, and Aroclor 1254. Surface and subsurface contaminant migration has occurred at the site. The affected area includes tundra west and south of the Garage, the soil underneath the building, and the gravel pad north of the Garage that is adjacent to the Gasoline Storage Area (the volume of gravel from the Gasoline Storage Area has been combined with gravels from the Garage in the evaluation for the FS).

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. The ERA concluded that the overall potential risks presented by site contaminants are low. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of DRPH, GRPH, RRPH, and BTEX detected in gravel, soil, and tundra at the site, however, exceed ADEC guidance cleanup levels. Therefore, the site is being recommended for remedial action. The affected volume at the site includes approximately 3,333 cubic yards of gravel, 222 cubic yards of tundra west and south of the Garage and 370 cubic yards of soil beneath the structure. The remedial action alternative recommended for the tundra, gravel, and soil beneath the structure at the site is enhanced bioremediation. A complete description and evaluation of the remedial alternatives considered for this site are presented in the FS, Section 5.0.

Old Sewage Area Petroleum Spill (SS11). This site consists of tundra and gravel pad areas located approximately 200 feet north and northeast of the module train (Figure 4-4, page 4-75). The old sewage area is located north of the module train at the terminus of an old sewage outfall pipe. To the west of the outfall pipe are tundra and gravel pad areas where a petroleum spill is suspected. This area is just south of the installation's diesel tanks.

Sampling and analyses have determined that several small limited areas at the Old Sewage Area Petroleum Spill (SS11) site are contaminated with petroleum hydrocarbons (DRPH, GRPH, RRPH), VOCs (including BTEX) primarily associated with gasoline and diesel fuels, and solvents. The affected area at the site is the tundra at the end of the old sewage outfall pipes, the soil beneath the module train, and the tundra on the west side of the gravel pad. The affected areas appear to be localized, and migration of contaminants from the site appear to be minimal.

The risk assessment concluded that risks posed to ecological receptors by site contaminants are minimal given current site uses. A potential human health hazard was identified in surface water from manganese. This potential is based on a future scenario in which the site surface water would be used as a sole drinking water supply. Even using the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action (i.e, cancer risks $>1 \times 10^{-4}$ or noncancer hazard significantly greater than 1). Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of DRPH, GRPH, RRPH, and BTEX detected in tundra at the site, however, exceed ADEC guidance cleanup levels. Therefore, the site is being recommended for remedial action. The affected area at the site includes 741 cubic yards of tundra including the disturbed tundra area below the module train. The recommended alternative for the site is enhanced bioremediation. A complete description and evaluation of the remedial alternatives considered for this site are presented in the FS, Section 5.0.

CONCLUSIONS

To meet the Air Force's commitment to identify, quantify, and remediate waste disposal sites at installations throughout the United States, the prime contractor completed an RI/FS at eight sites at the Oliktok Point radar installation. The investigation was completed in accordance with the guidelines established in the Air Force's IRP. The RI/FS involved field investigations, sampling, and analysis.

Based on the RI sampling and data analyses and quantitative risk assessment, the Air Force has concluded there is no risk associated with observed conditions and recommends no further remedial action for four of the eight sites. These sites, presented in Table ES-2, are the Old Landfill (LF01), Dump Site (LF02), Dock Storage Area (ST03), and POL Storage (ST04). At the remaining four sites contaminant levels may represent a potential risk to receptor populations or exceed ADEC cleanup guidance levels. It is recommended that remedial actions be conducted at these sites: Diesel Spill (SS05), Gasoline Storage Area (ST08), Garage (SS10), and Old Sewage Area Petroleum Spill (SS11). The remedial action alternatives recommended for these four sites are presented in Table ES-3.

TABLE ES-2. SITES RECOMMENDED FOR NO FURTHER ACTION

SITE NAME	SITE ID NUMBER
Old Landfill	LF01
Dump Site	LF02
Dock Storage Area	ST03
POL Storage	ST04

TABLE ES-3. SITES RECOMMENDED FOR REMEDIAL ACTION

SITE	SITE ID NUMBER	MEDIA	RECOMMENDED ALTERNATIVE
Diesel Spill	SS05	• Gravel • Tundra	Enhanced bioremediation
Gasoline Storage Area	ST08	• Tundra	Enhanced bioremediation
Garage	SS10	• Gravel • Tundra • Soil beneath the Garage	Enhanced bioremediation
Old Sewage Area Petroleum Spill	SS11	• Tundra	Enhanced bioremediation

1.0 INTRODUCTION

The United States Air Force (Air Force) has prepared this Remedial Investigation/Feasibility Study (RI/FS) report to present the results of RI/FS activities at eight sites located at the Oliktok Point radar installation (Oliktok Point). The Remedial Investigation (RI) field activities were conducted at the Oliktok Point radar installation during the summer of 1993. The eight sites at Oliktok Point were investigated because they were suspected of being contaminated with hazardous substances. The RI/FS was conducted in accordance with the requirements of the Air Force Installation Restoration Program (IRP). RI activities were conducted using methods and procedures specified in the RI/FS Work Plan, Sampling and Analysis Plan (SAP), and Health and Safety Plan (U.S. Air Force 1993a,b,c).

Section 1.0 of this report presents information concerning the objectives and implementation of the IRP, a description of the installation and the environmental setting at Oliktok Point, and brief background information on the eight Oliktok Point sites. Project activities, including project objectives and scope, summaries of field and laboratory methods, methodologies for data evaluation and risk estimation, and a summary of background sampling, analytical results, and migration pathways are described in Section 2.0. Section 3.0 documents the RI sampling and analysis results on a site-by-site basis for the four sites where no further action is recommended, identifies potential migration pathways and receptors, summarizes the human health and ecological risks, and describes the conclusions and recommendations for each of these sites. Section 4.0 documents the RI sampling and analysis results on a site-by-site basis for the four sites where remedial actions may be warranted; identifies all Applicable or Relevant and Appropriate Requirements (ARARs), potential migration pathways, and receptors; summarizes the human health and ecological risks; and describes the conclusions and recommendations, including the recommended remedial alternative for cleanup at each of the sites. Section 5.0 presents the Feasibility Study (FS) of potential remedial actions for the sites that may require cleanup.

The recommended actions for each of the sites, presented in Sections 3.0 through 5.0, are preliminary. The actions for each site will be determined only after review of this RI/FS document and the Oliktok Point Risk Assessment (U.S. Air Force 1996) by regulatory agencies and interested parties. During the decision process the public will be notified through fact sheets and public notices as to the recommended action for each site and will be given the opportunity to comment on the proposed action for each site.

Appendix A provides references and a list of acronyms used in this document. Appendix B presents photographs of the Oliktok Point radar installation and sites. Appendix C is the Statement of Work describing the scope of the RI/FS activities at the Oliktok Point radar installation. Sample collection logs are presented in Appendix D; sample Chain-of-Custody forms are in Appendix E. Cross-reference tables and analytical data are presented in Appendix F, and data validation reports are in Appendix G.

1.1 THE UNITED STATES AIR FORCE INSTALLATION RESTORATION PROGRAM

The Air Force IRP is the basis for assessment and response action on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The Air Force IRP is designed to identify, confirm/quantify, and remedy problems associated with past and present management of hazardous substances and hazardous wastes at Air Force facilities. CERCLA defines a hazardous substance in Section 101; the definition includes, as examples, any substance designated pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act (FWPCA), any element, compound, mixture, solution, or substance designated pursuant to Section 102 of CERCLA, and hazardous wastes identified pursuant to Section 3001 of the Resource Conservation and Recovery Act (RCRA). A hazardous waste, as defined in RCRA, "may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of or otherwise managed" (Section 1004[2][B] of RCRA).

The Department of Defense (DOD) initiated the IRP in 1976 to identify, investigate, and mitigate environmental hazardous waste contamination that may be present at DOD facilities. In June 1980, DOD issued Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6, requiring identification of past hazardous waste disposal sites at DOD agency installations. The Air Force implemented DEQPPM 80-6 in December 1980 and revised it in 1981.

Executive Order 12316 of 14 August 1981 directed the military to design its own program to remedy uncontrolled hazardous waste disposal sites consistent with the National Contingency Plan (NCP) established by CERCLA. In response to the directive, the DOD instructed its branches to identify hazardous waste disposal sites to which they contributed wastes, and to comply with environmental regulations at the installation level when implementing cleanup. DOD subsequently developed the basic IRP after which the Air Force IRP was modeled. DEQPPM 81-5 of 11 December 1981, implemented by Air Force Headquarters in January 1982, sets forth the basic authority and objectives for the Air Force programs.

The Superfund Amendments and Reauthorization Act of 1986 (SARA) augmented the scope and requirements of CERCLA and provided specific directives to federal facilities regarding investigation of waste disposal sites. Under SARA, technologies that provide permanent removal or destruction of hazardous wastes or contaminants are preferable to actions that only contain or isolate the materials. SARA also provides for greater interaction with public and state agencies and expands the role of the Environmental Protection Agency (EPA) in the evaluation of the health risks associated with contamination. SARA requires early determination of ARARs and the consideration of potential remediation alternatives at the initiation of an RI/FS. Remedial actions taken under CERCLA must comply with ARARs, which generally consist of federal, state, and local regulations. Remedial actions at facilities regulated under CERCLA are selected based on the results of an RI/FS. The RI/FS process is described in the NCP. The RI phase includes specific steps for determining the nature and extent of environmental contamination. Subsequently, the FS is implemented to evaluate alternative remedial actions prior to selection of the most appropriate action for a specific facility.

To respond to changes in the NCP brought about by SARA, the Air Force modified its IRP in November 1986 to improve continuity in the site investigation and remedial planning process for Air Force installations. In July 1987 the President signed Executive Order 12580, delegating responsibility to secretaries of various agencies to conduct site investigations and remedial actions at federal facilities. The order defined relationships between various federal and state agencies and assigned EPA the role of facilitator in resolving conflicts.

Prior to 1988 the Air Force IRP was organized into four phases, described below:

- Phase I, Installation Assessment/Records Search, identified past waste disposal sites at Air Force installations that might pose a hazard to public health or the environment. Sites identified during Phase I could be recommended for no further action, confirmation studies (Phase II), or remedial action (Phase IV).

- Phase II, Confirmation/Quantification, was intended to define and quantify contamination present at sites identified during Phase I. Stage 1 of Phase II consisted of an initial assessment, including environmental sampling, to determine whether contamination was present. Depending on the results of Stage 1, subsequent stages of investigation could be recommended to improve the characterization of site contamination.

- Phase III, Technology-Based Development, included development of new technologies for treating contaminants identified at Air Force installations. The results of Phase II investigations were used to determine the need for Phase III activities.

- Phase IV, Remedial Action, involved development and implementation of plans to remedy contamination at sites.

In 1988, the Air Force replaced the phased approach of the IRP with an approach more closely resembling the RI/FS approach used by EPA. Under this approach, Phase II investigations and Phase IV remedial action planning are conducted in a more parallel fashion to expedite implementation of site cleanups.

1.2 INSTALLATION DESCRIPTION AND ENVIRONMENTAL SETTING

The Oliktok Point Distant Early Warning (DEW) Line installation, also known as POW-2, is located on Oliktok Point, east of the Colville River on the north coast of Alaska; it occupies 2,325 acres. It is one of many DEW Line installations located across the arctic regions of North America and Greenland. The installations were designed to operate and maintain radar systems for the detection of aircraft that may be a threat to national security.

The Oliktok Point installation was constructed from 1954 to 1955 as an auxiliary DEW Line station. Nuiqsut, the nearest community, is located 30 miles away. Oliktok Point is approximately 40 miles northwest of Prudhoe Bay/Deadhorse and 14 miles northwest of the

ARCO Kuparuk camp. Most of the installation is less than 25 feet above mean sea level (MSL) and is adjacent to the sea. Facilities at the DEW Line station are the most prominent feature of the area.

The installation consists of one 25-module train, radome radar, and support facilities. The module train houses the living quarters, power generation plant, sewage and water systems, and incinerator; it is attached to the radome tower. Support facilities include diesel oil tanks, warehouse, garage, gravel airstrip, and hangar. The radome tower houses the rotating radar, which is supported on a steel-framed platform straddling the module train. A 4,020-foot-long gravel runway with no overrun is part of the support facilities.

A variety of past activities at the installation may have resulted in environmental contamination. The Air Force is investigating and remediating actual and potential sources of contamination through activities conducted under the IRP.

1.2.1 Physical Geography

The Oliktok Point radar installation is located at 70°30'N, 149°53'W on the north coast of Alaska. The 2,325-acre installation is situated on Oliktok Point. The general location of Oliktok Point radar installation is shown on Figure 1-1. An area location map is presented in Figure 1-2, and a site plan is provided on Figure 1-3.

1.2.2 Climate (Meteorological Conditions and Air Quality)

Annual precipitation at the Oliktok Point installation is 4.9 inches including 27 inches of snowfall. Strong wintertime westerly winds are common. They often occur with snowstorms and cause snow drifts. Equivalent chill temperatures are below -40°F on over half the days in January, February, and March. In summer, the cold air mass associated with the Arctic Ocean rides over the Arctic Coastal Plain, creating temperature inversions with cold air below and warmer air above. Such inversions break up when winds from the south or west bring warmer air into the coastal areas. Absolute temperature minimum and maximum ranges between -58°F and 78°F, respectively (Hart Crowser 1987).

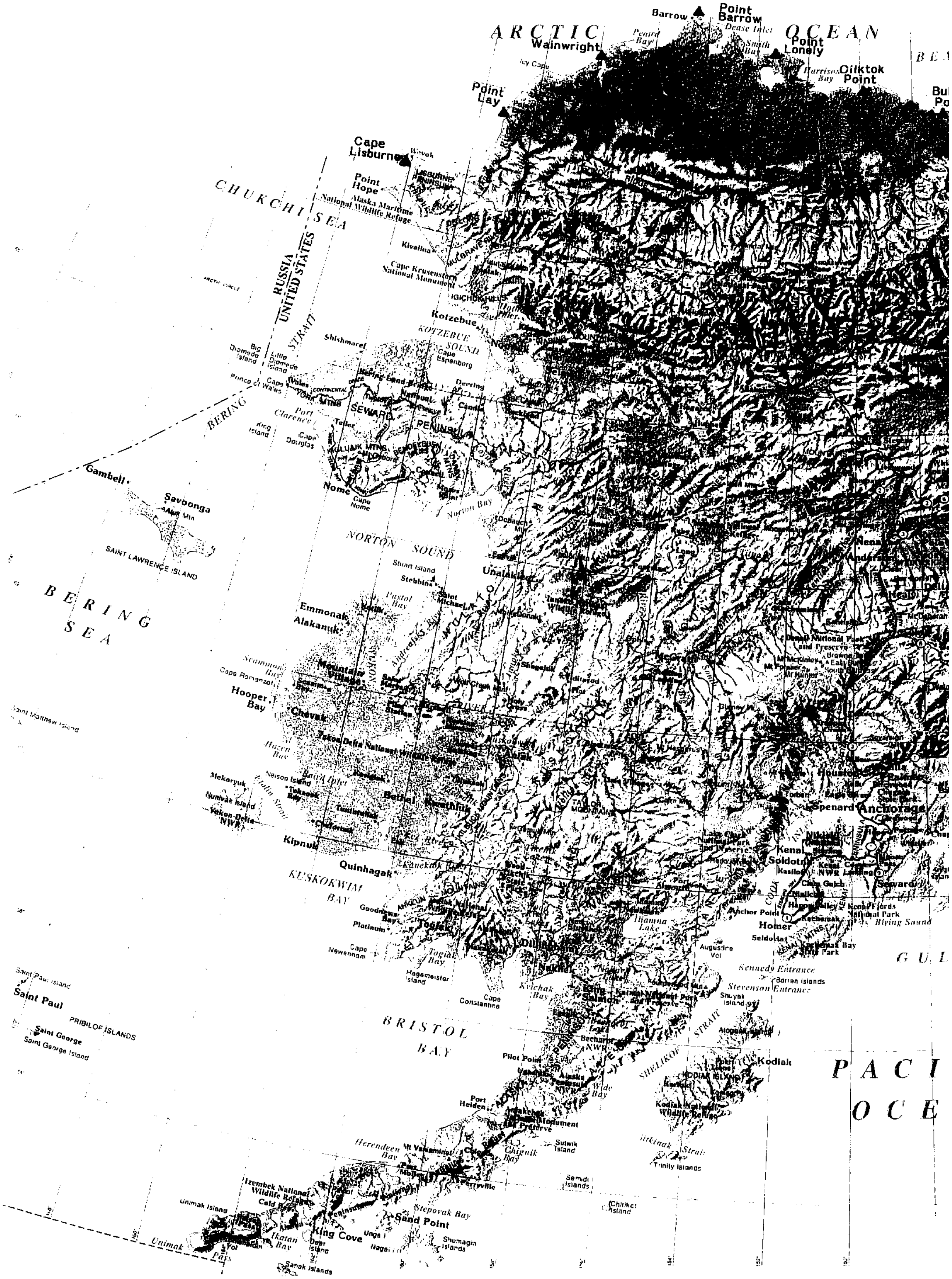
Because of very sparse development and the associated lack of major air pollution sources, air quality in the area is good. Air inversions are common, and the persistent light winds along the coastal plain prevent the development of air masses containing pollutants.

1.2.3 Geology

This section presents information on the regional and local geology of the Oliktok Point area.

1.2.3.1 Regional Geology. Geologic units of all the principal time-stratigraphic systems from Precambrian to Quaternary are represented in Alaska. For the last two or three million years, frost climates have prevailed in Alaska and the geomorphic processes have been either periglacial or glacial (Wahrhaftig 1965). Although glacial activity was extensive, it was by no means all-encompassing. Glaciation is evident in many parts of the state including the Pacific

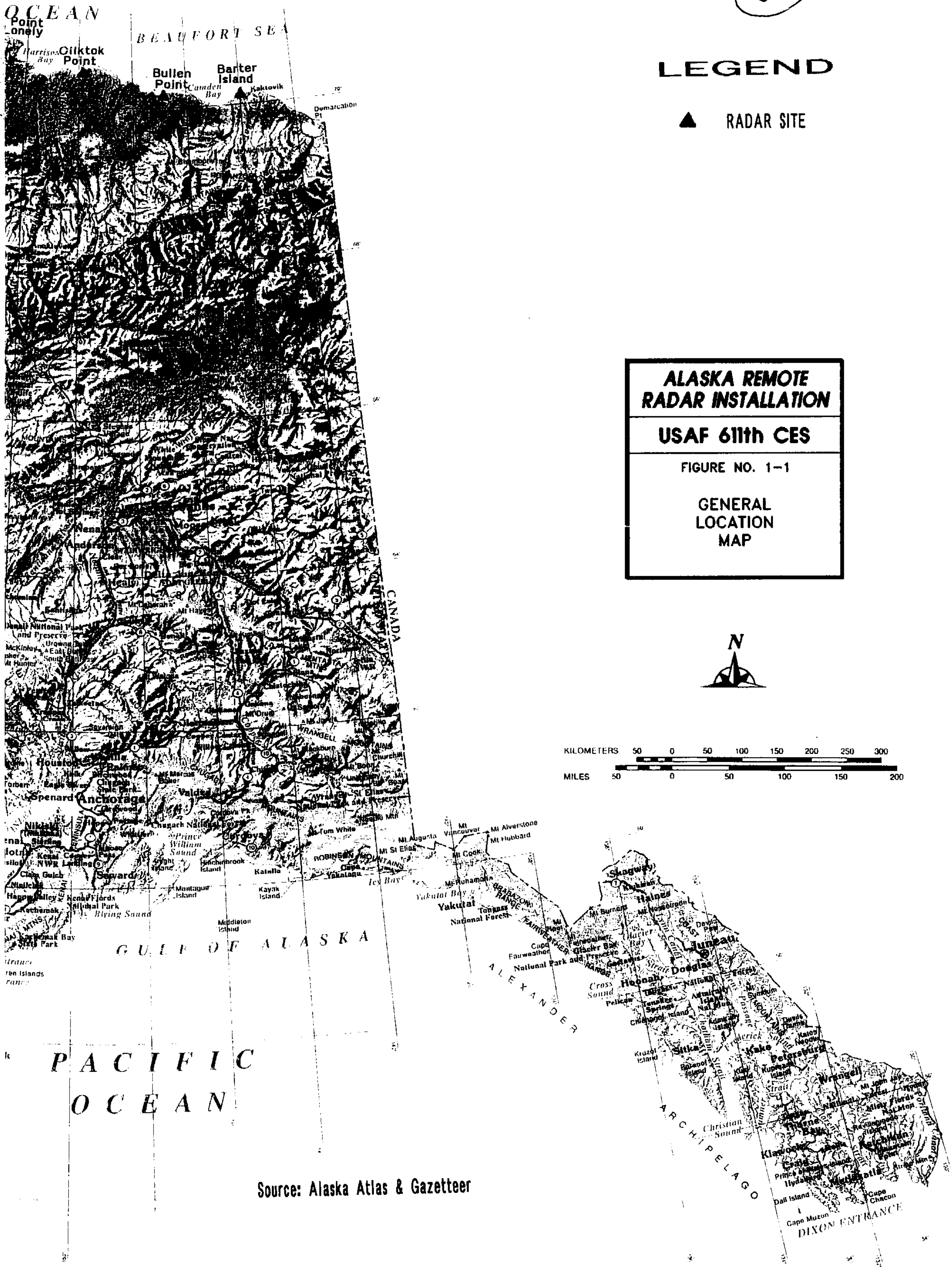
1


ARCTIC OCEAN
Barrow
Point Barrow
Wainwright
Point Lonely
Oliktok Point
Point Lay
Cape Lisburne
Point Hope
CHUKCHI SEA
RUSSIA
UNITED STATES
Kivalina
Kotzebue
KOTZEBUE SOUND
Shishmaref
Wales
BERING STRAIT
SEWARD PENINSULA
Nome
Gambell
Savoonga
SAINT LAWRENCE ISLAND
BERING SEA
NORTON SOUND
Unalakleet
Stebbins
Emmonak
Alakanuk
Hooper Bay
Chevak
Bethel
Kipnuk
Quinhagak
KUSKOKWIM BAY
Dillingham
BRISTOL BAY
Saint Paul
PRIBILOF ISLANDS
Saint George
Pilot Point
Port Heiden
King Cove
Sand Point
Kodiak
Homer
Kenai
Soldotna
Seward
Anchorage
Spenard
Houston
PACIFIC OCEAN

(2)

LEGEND

▲ RADAR SITE



ALASKA REMOTE RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 1-1

GENERAL LOCATION MAP

N

KILOMETERS 50 0 50 100 150 200 250 300

MILES 50 0 50 100 150 200

Source: Alaska Atlas & Gazetteer

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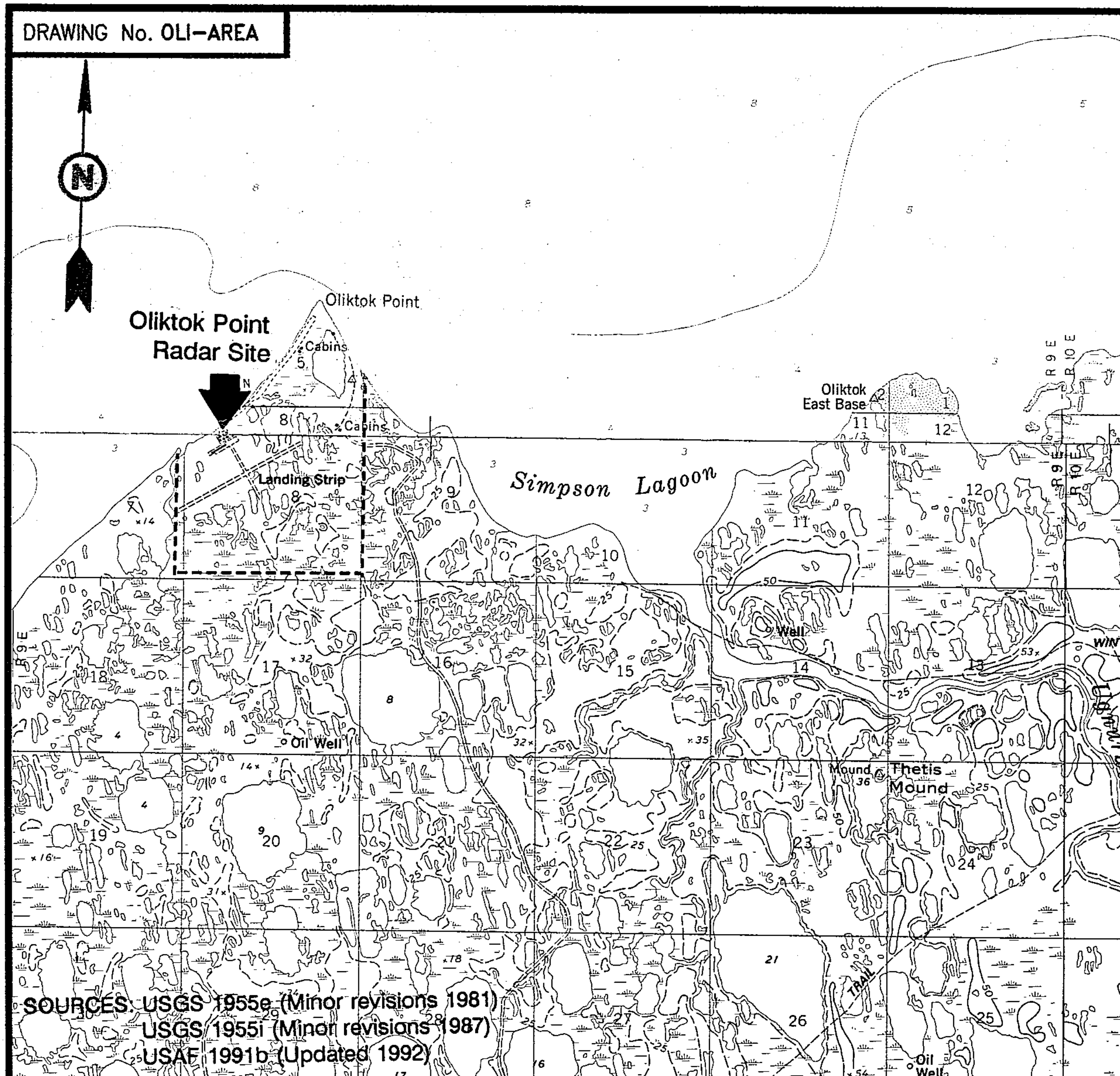

OLIKTOK POINT RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 1–2

AREA LOCATION MAP

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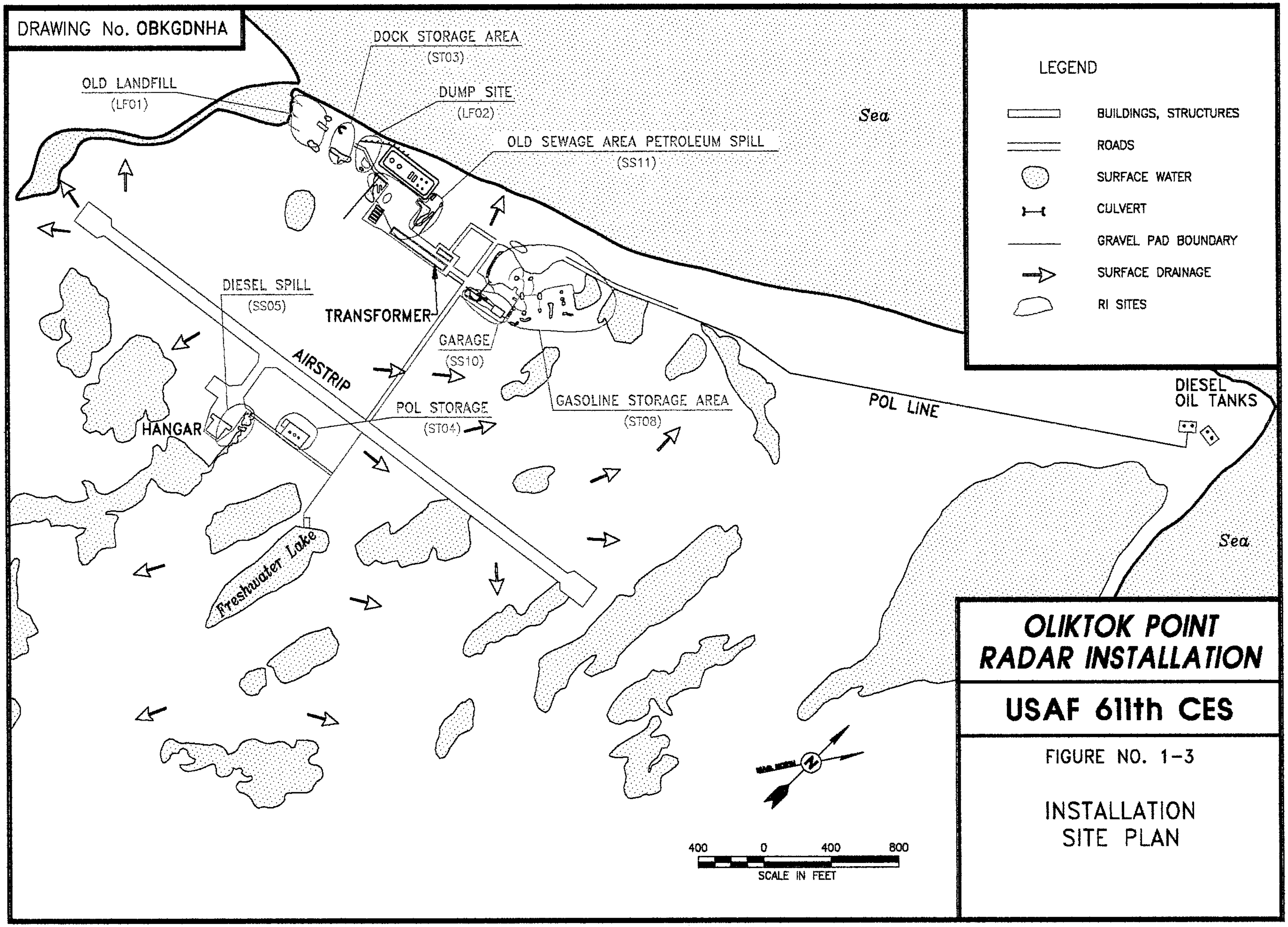

OLIKTOK POINT RADAR INSTALLATION

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FIGURE NO. 1-3

INSTALLATION SITE PLAN

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Mountain System, Arctic Mountains, Ahklun Mountains, and southern Seaward Peninsula. Some great expanses, however, received no glacial activity. The principal areas not glaciated include the Intermountain Plateaus, Arctic Foothills, and Arctic Coastal Plain. Many periglacial features such as polygonal ground, sorted circles, pingos, and ice wedges can be observed on the Arctic Coastal Plain. Figure 1-4 depicts the extent of Alaska's glacial areas.

Alaska's generally cold climatic regime has produced permafrost, a combination of geologic, hydrologic, and meteorologic characteristics that produces permanently frozen ground. Permafrost occurs in both unconsolidated sediments and bedrock; its distribution includes most of the state, with the notable exception of the Pacific coastal area. Permafrost is continuous on the Arctic Coastal Plain and has a significant impact on the flow of ground and surface water. The distribution of Alaska's permafrost areas is shown on Figure 1-5. Permafrost is discussed in detail in Section 1.2.4.1.

The very strong geologic processes at work in Alaska have produced a unique environmental setting reflected in the general geology of the Arctic Region (Figure 1-6). A popular theory of the formation of the Arctic Region is that it was once an ocean basin adjacent to the Canadian Shield. Rifting of the Canadian Shield occurred during Mesozoic time, and the Arctic Region drifted southwest forming the Colville Basin to the south and the Arctic Ocean to the north. At the same time, the Brooks Range orogeny began creating a source for the newly-created Colville Basin. Continued uplift of the Brooks Range produced a prograding delta that filled in the Colville Basin.

1.2.3.2 Local Geology. The Oliktok Point installation is located approximately 3/4 mile southwest of Oliktok Point, a point of land extending northward toward the Beaufort Sea. The installation elevation ranges from about 6 to 29 feet MSL. The geology of the installation is similar to that discussed in the regional overview (Section 1.2.3.1). The principal soils consist of a tundra mat underlain by 21 to 33 feet of poorly-drained Holocene and Pleistocene sands, gravels, silts, and clays, and organic silt and sand deposited in the marine, alluvial, fluvial, eolian, and lacustrine environments of the Gubik Formation. The Gubik Formation overlies the consolidated Cretaceous sedimentary bedrock of the Nanushuk Group (Williams 1983). Beach erosion rates average 3 to 15.4 feet per year.

The Oliktok Point installation and much of the surrounding area are dotted with many small lakes and swamplands. These are typically low, flat areas composed of fine sands and silts which are thermokarst or "thaw lake" deposits. The shoreline areas are typically composed of coarser sandy bar and estuarine deposits (Williams 1983).

Coal, oil, and gas deposits may be present in the area; significant oil exploration and production have been conducted east of the installation at Kaparuk and Prudoe Bay. Grantz et al. (1980, 1982) and Espinosa and Michael (1984) show low to negligible seismic activity in the installation area.

1.2.4 Hydrology

Ground water/permafrost and surface water are discussed in the following sections.

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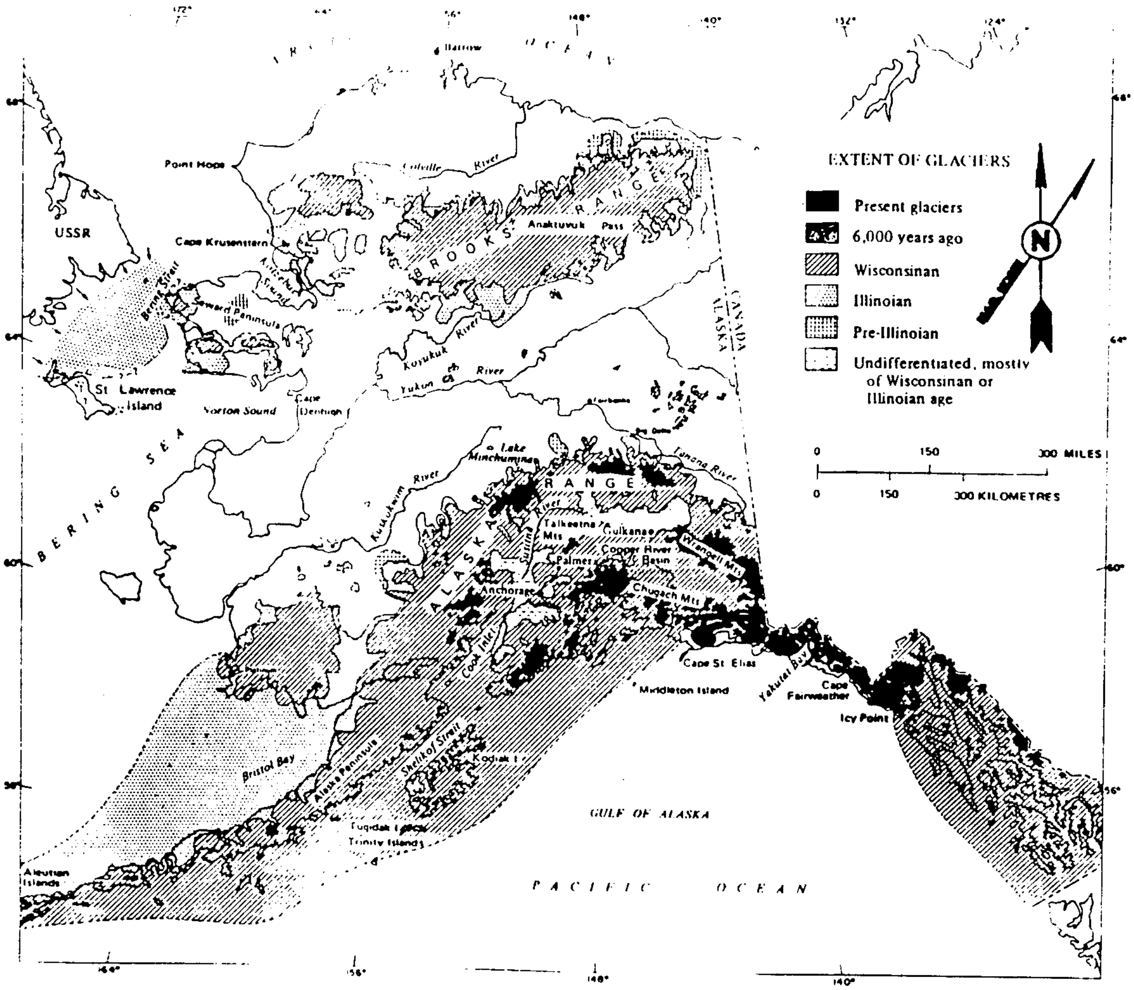

ALASKA REMOTE RADAR INSTALLATIONS

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FIGURE NO. 1-4

QUATERNARY GLACIATION IN ALASKA

SOURCE: Pewe 1975

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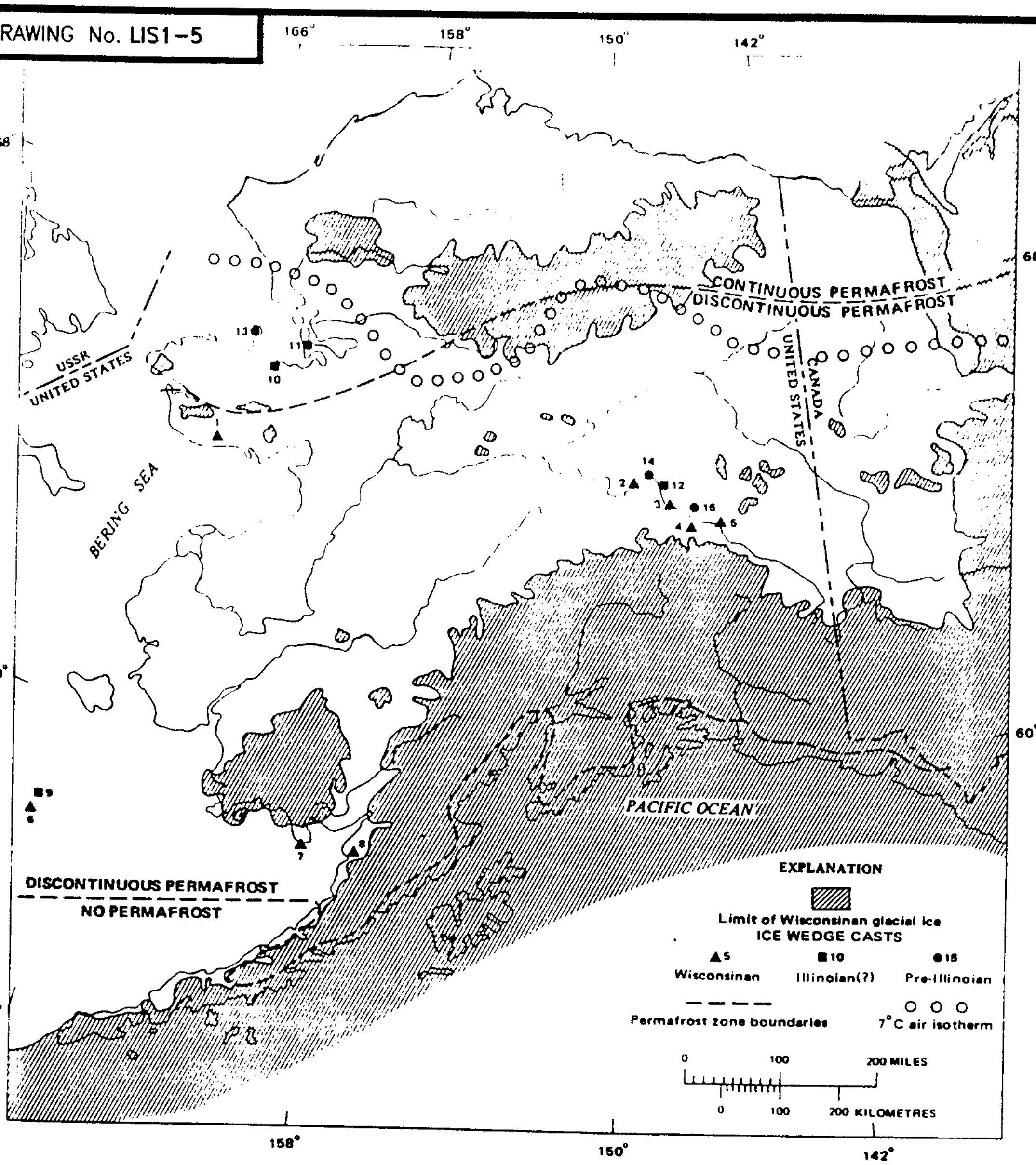

ALASKA REMOTE RADAR INSTALLATIONS

USAF 611th CES

FIGURE NO. 1-5

PERMAFROST MAP

SOURCE: Pewe 1975

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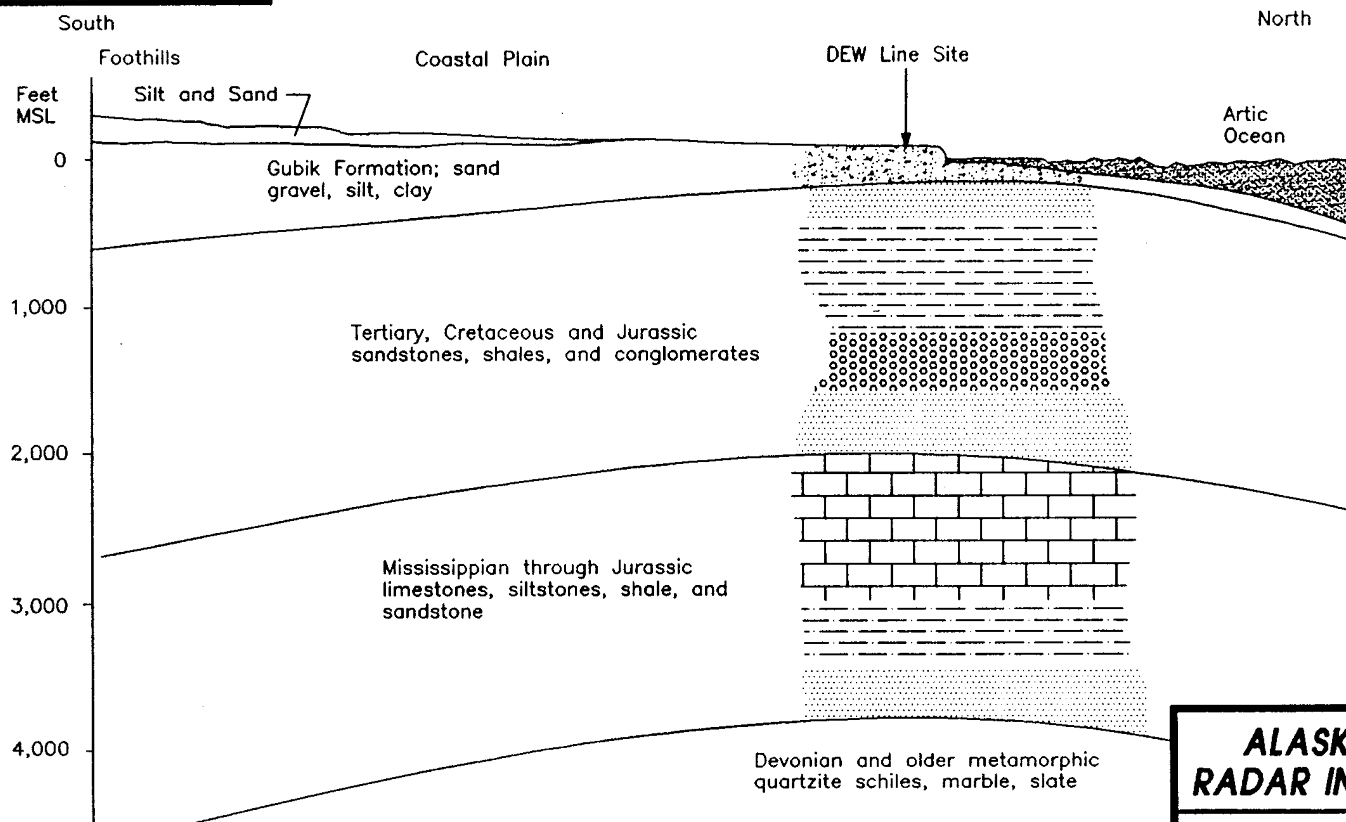

SOURCE: CH2M HILL 1981

Not to Scale

ALASKA REMOTE RADAR INSTALLATIONS

USAF 611th CES

FIGURE NO. 1-6

GENERALIZED NORTH-SOUTH GEOLOGIC CROSS SECTION

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1.2.4.1 Ground Water/Permafrost. Permafrost has a profound influence on Alaska's ground water resources. Permafrost is defined by the *Glossary of Geology* (American Geological Institute 1972) as:

- Any soil, subsoil, or other surficial deposit, or even bedrock, occurring in arctic or subarctic regions at a variable depth beneath the earth's surface in which a temperature below freezing has existed continuously for a long time (from two years to thousands of years). This definition is based exclusively on temperature and disregards the texture, degree of compaction, water content, and lithologic character of the material.

Permafrost has a major impact on the relationship between surface water and ground water in cold regions such as Alaska. Although ground water in permafrost regions follows the same geologic and hydrologic principles as in temperate areas, the hydrologic regime is modified in the following ways:

- Permafrost acts as an impermeable barrier to the movement of ground water because pore spaces are ice-filled in the zone of saturation. Recharge and discharge are, therefore, limited to unfrozen channels penetrating the permafrost zone. The unfrozen channels are termed perforating taliks. Permafrost restricts the downward percolation of water and increases runoff, enhancing the creation of lakes and swamps (Feulner et al. 1971).

- Permafrost zones tend to reduce evapotranspiration. The generally low ground temperatures tend to reduce direct evaporation and transpiration (the escape of moisture through plant tissue into the air). Vegetation growth is enhanced near large surface water bodies where permafrost usually occurs at greater depth.

- Permafrost restricts an aquifer's storage capacity and the number of locations from which ground water may be withdrawn. Subpermafrost ground water occurs beneath the permafrost zone and is usually dependable. Suprapermafrost water occurs in the active zone, above the permafrost table, and tends to be seasonal; it freezes during the cold winter months.

- The ground water temperature varies from 32 to 40.1°F in permafrost regions because of the low ground temperatures (Williams 1970). Water tends to be more viscous in this temperature range and, therefore, moves slower than in temperate regions.

Low ground temperatures create the necessary environment for permafrost to form. The segment above the permafrost table is called the active zone, because it freezes and thaws with seasonal weather changes. The permafrost zone remains frozen year-round. The active zone is significant because suprapermafrost active zone water exists within it.

Ground water has been found in aquifers beneath the continuous permafrost, but little is known of these aquifer systems. Shallow ground water sources are also present in river gravel and in thaw bulbs beneath deep lakes. Active zone water is found during the summer months when this layer thaws, but the layer is relatively thin. The thickness of the active zone at Oliktok Point ranged from approximately one to six feet during the 1993 RI.

Surface features may have dramatic impacts on the subsurface distribution of permafrost because they influence heat transfer. Heat flow through surface water is greater than through land. Permafrost may be discontinuous or present at greater depth under and near large bodies of water such as rivers or deep lakes. Smaller bodies of water may affect the configuration of the permafrost surface or the total thickness of the permafrost at any given point. Figure 1-7 is a generalized representation of the relationship of surface features to the underlying permafrost.

1.2.4.2 Surface Water. The Oliktok Point installation is located on a slight rise surrounded by depressions containing ponds and swampy areas during the summer months. Larger thaw lakes occur approximately 0.5 to 1.5 miles south of the facility. The swampy conditions can be attributed to poor evaporation, low relief resulting in poor drainage, and extensive permafrost that inhibits underground seepage (Payne et al. 1952). String bogs are typical features of the flat thaw lake plains.

Surface drainage is poor and runoff occurs through a system of sluggish ephemeral streams or as sheet flow. Surface water drainage features in the vicinity of the installation are presented in Figure 1-8. A small stream about three miles long, flowing into the Beaufort Sea, drains the area west of the runway. Three miles east of the installation, the Ugnaravik River drains into Simpson Lagoon.

The installation is moderately susceptible to coastal flooding due to the low elevation. This can cause salt water encroachment of the fresh water supply; however, all areas are not hydraulically connected to Fresh Water Lake, which provides the local drinking water supply.

1.2.5 Industrial Activities

Primary industrial activities at the installation include operation and maintenance of the radar system. The Oliktok Point radar installation was built to support the air defense system in Alaska. The installation became operational in 1955 when communications were provided by high frequency radio. The original equipment still remains but was replaced with new Long Range Radar and satellite earth terminal systems, which are presently operational. Other industrial activities include maintenance associated with facility operation such as minor construction, road upkeep, and vehicle maintenance. Currently there are approximately two people stationed at the Oliktok Point installation.

Presently the installation consists of one module train, rotating radar, garage, warehouse, petroleum, oil, and lubricant (POL) tanks, hangar, and runway. The module train contains the electronic equipment work areas and the radar tower, personnel quarters, administration offices, a mechanical room with emergency boiler and fuel storage, a personnel support module with

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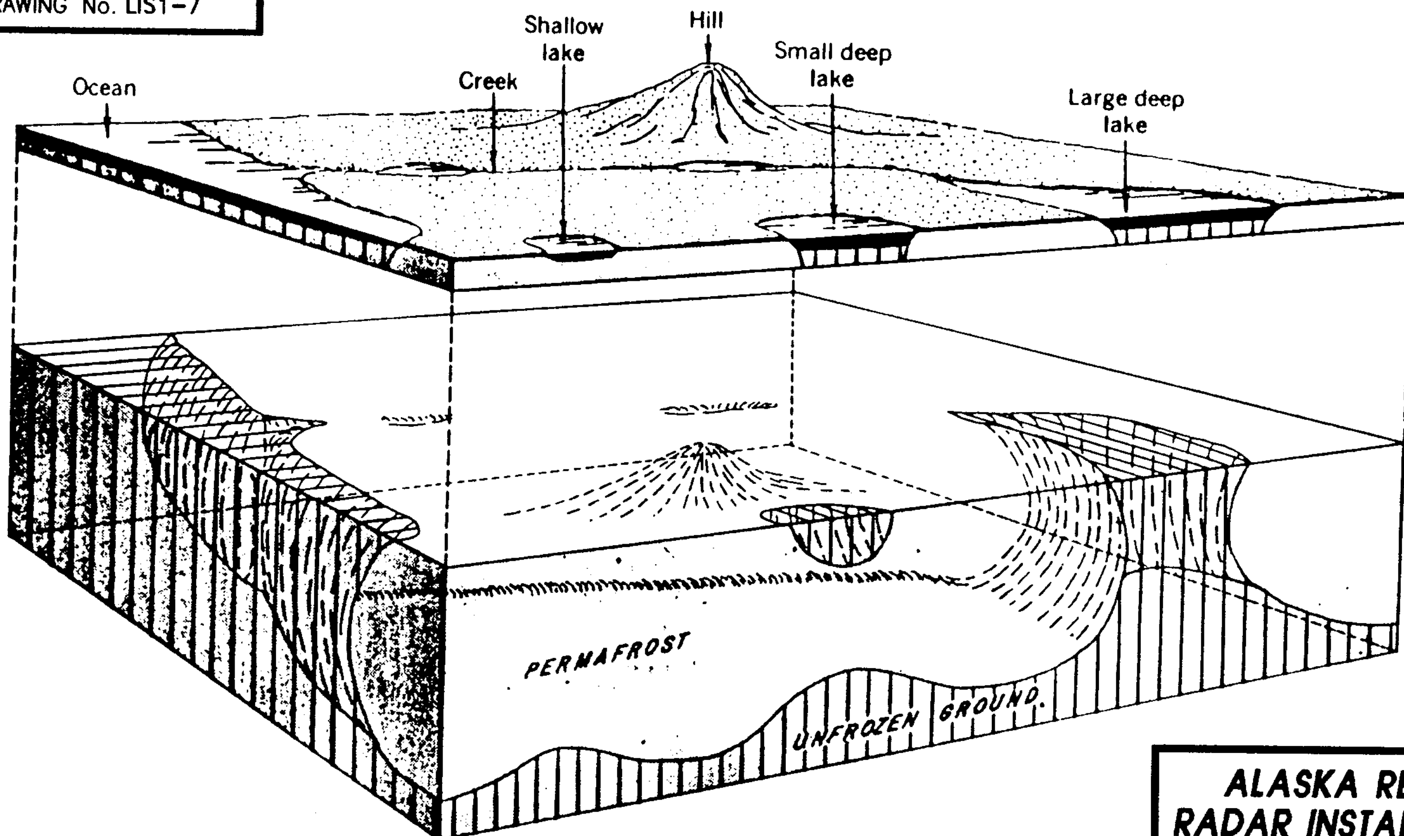

SOURCE: Selkregg 1975

ALASKA REMOTE RADAR INSTALLATIONS

USAF 611th CES

FIGURE NO. 1-7

SURFACE FEATURE IMPACTS ON PERMAFROST DISTRIBUTION

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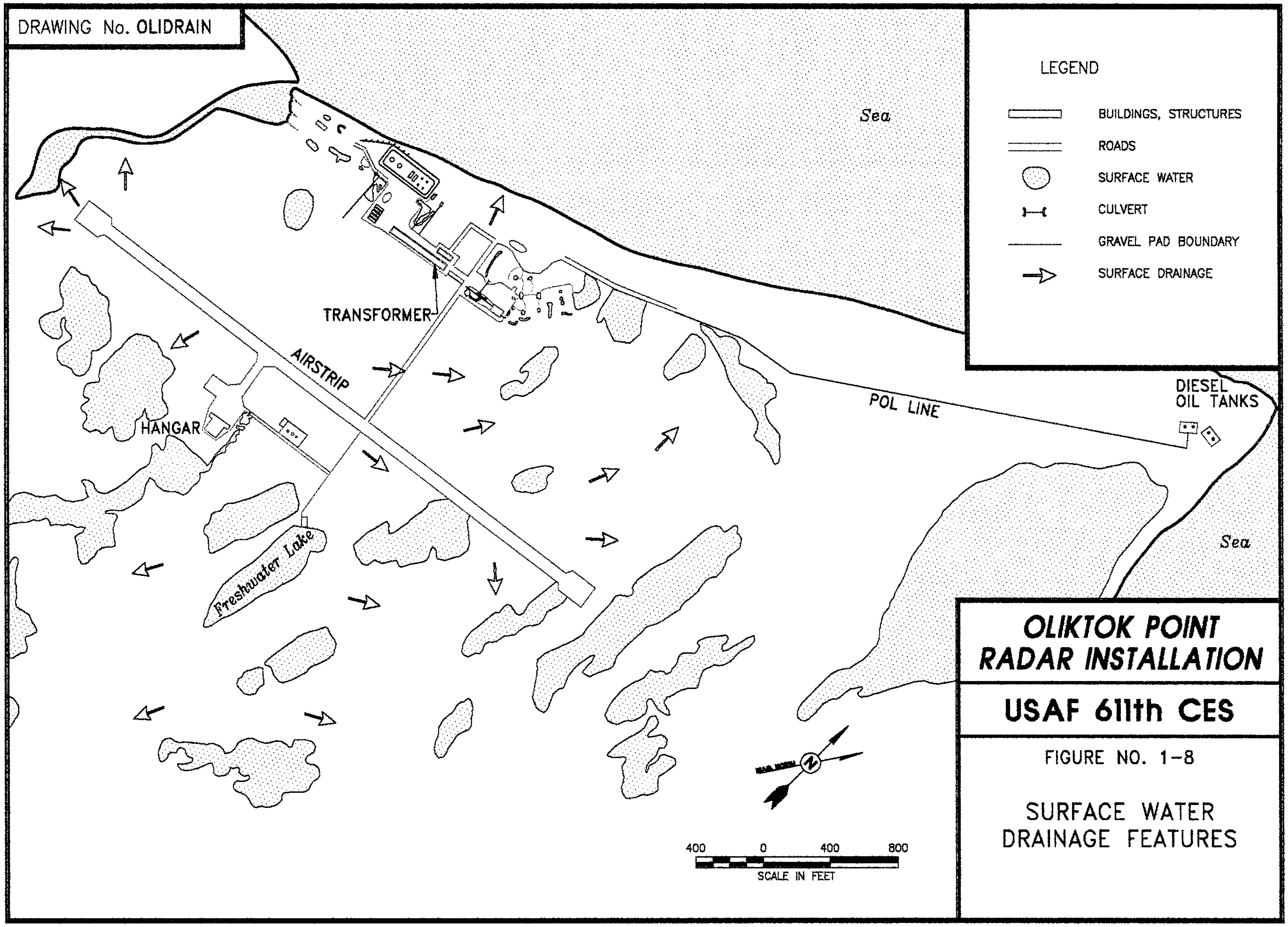
DRAWING No. OLIDRAIN
LEGEND
BUILDINGS, STRUCTURES
ROADS
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
Sea
Sea
TRANSFORMER
AIRSTRIP
HANGAR
Freshwater Lake
POL LINE
DIESEL OIL TANKS
N
400 0 400 800
SCALE IN FEET
OLIKTOK POINT RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 1-8
SURFACE WATER DRAINAGE FEATURES

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water storage, shower, and toilets, and dining, kitchen, and recreation areas. The radar system is operated to detect any aircraft that may enter U.S. air space.

1.2.6 Biology

This section presents information on the regional fauna and flora of the Oliktok Point area.

1.2.6.1 Vegetation. Three major vegetative habitats exist in the Oliktok Point area: coastal wetlands and beaches, wet sedge meadows, and tundra. The installation environment is predominantly comprised of low wet meadow. This habitat typically supports ponds dominated by *Carex aquatilis* and pendent grass, *Arctophila fulva*. Other plants variously associated with these wetlands include cotton grass, *Eriophorum* spp.; tundra grass, *Dupontia fischeri*; buttercup, *Ranunculus pallassi*; marsh marigold, *Caltha palustris*; and the mosses, *Calliergon* spp. and *Drepanocladus* spp. Drier sites along polygon rims and high-centered polygons support plant communities consisting of a variety of sedges, *Carex* spp.; tundra grass; polar grass, *Arctagrostis latifolia*; saxifrage, *Saxifraga* spp.; avens, *Dryas* spp.; lousewort, *Pedicularis* spp.; and the mosses, *Onchophorus* spp., *Tomenthypnum* spp., and *Pogonatum* spp. Coastal wetlands and beaches range from barrens to wet saline associations. Characteristic plants are *Cochlearia* spp.; chickweed, *Stellaria* spp.; *Puccinellia* spp.; sedges; tundra grass; lyme grass, *Elymus arenarius*; and oysterleaf, *Mertensia maritima* (Hart Crowser 1987).

1.2.6.2 Fish. Principal species of fish in the vicinity of the Oliktok Point installation include arctic char, *Salvelinus alpinus*; arctic cisco, *Coregonus autumnalis*; broad whitefish, *C. nasus*; humpback whitefish, *C. pidschian*; and grayling, *Thymallus arcticus*. Small runs of salmon, *Oncorhynchus* spp., occur in the Colville and Sagavanirktok Rivers, and chinook salmon, *O. tshawytscha*, and sockeye salmon, *O. nerka*, have been reported in Simpson Lagoon. Because of the abundance of wetland lakes and ponds, the proximity of the Ugnuravik River, the Colville and Sagavanirktok Rivers (principal rivers for anadromous species), and the presence of Simpson Lagoon, the area is important for seasonal rearing and feeding activities for most species of arctic fish (Hart Crowser 1987).

1.2.6.3 Birds. An estimated 180 species of shorebirds, waterfowl, and other birds use the wetlands and aquatic habitats adjacent to Oliktok Point in their annual migrations. Fifty-three species are thought to be regular or intermittent breeders in the area. Principal breeding species include arctic loon, *Gavia arctica*; eiders, *Somateria* spp.; mallard, *Anas platyrhynchos*; oldsquaw, *Clangula hyemalis*; American golden plover, *Pluvialis dominica*; black-bellied plover, *P. squatarola*; long-billed dowitcher, *Limnodromus scolopaceus*; ruddy turnstone, *Arenaria interpres*; pectoral sandpiper, *Calidris melanotos*; semipalmated sandpiper, *C. pusillus*; dunlin, *C. alpina*; red phalarope, *Phalaropus fulicarius*; northern phalarope, *P. lobatus*; parasitic jaeger, *Stercorarius parasiticus*; glaucous gull, *Larus hyperboreus*; and arctic tern, *Sterna paradisaea* (Hart Crowser 1987; U.S. Fish and Wildlife Service 1982).

Two species of passerines, the Lapland longspur, *Calcarius lapponicus*, and the snow bunting *Plectrophenax nivalis*, have been observed breeding at Point Storkerson, 17 miles southeast of the installation, and they may be present in the vicinity of the installation. However, passerine

occurrence is relatively limited along the Arctic Coastal Plain, especially when compared to the abundant waterfowl and shorebird populations.

Simpson Lagoon and the numerous lakes in the area figure prominently in molting and premigratory staging activities. These activities begin in late June and extend through September. Principal species in this area are eiders; loons, *Gavia* spp.; geese, *Branta* and *Chen* spp.; oldsquaw; brant, *Branta bernicla*; and numerous shorebirds (Hart Crowser 1987).

Year-round avian residents at the Oliktok Point installation include ptarmigan, *Lagopus* spp.; snowy owl, *Nyctea scandiaca*; and common raven, *Corvus corax*.

1.2.6.4 Mammals. Principal marine mammals that inhabit the waters off Oliktok Point include beluga, *Delphinapterus leucas*; bowhead whale, *Balaena mysticetus*; gray whale, *Eschrichtius robustus*; ringed seal, *Phoca hispida*; and bearded seal, *Erignathus barbatus*. Beluga sometimes may be seen in coastal lagoons. Ringed seals are the predominant pinniped and, although common in the winter, are seen less frequently at coastal locations during the summer. Polar bears, *Ursus maritimus*, may be present year-round, but are more likely to be in the area during the winter.

Small terrestrial mammals include those species typically associated with wet sedge tundra habitats. Principal species found in the vicinity of the Oliktok Point installation include masked shrew, *Sorex cinereus*; collared lemming, *Dicrostonyx groenlandicus*; brown lemming, *Lemmus trimucronatus*; short-tailed weasel, *Mustela erminea*; least weasel, *M. nivalis*; and arctic fox, *Alopex lagopus* (Hart Crowser 1987). Brown lemmings are the predominant rodent herbivore. The gray wolf, *Canis lupus*, and grizzly bear, *Ursus arctos*, are occasionally seen near the installation. Barren-ground caribou, *Rangifer tarandus*, of the central arctic herd, range throughout the area; the installation is within the caribou's principal calving grounds.

1.2.6.5 Endangered Species. Threatened or endangered species potentially occurring in the vicinity of the Oliktok Point installation include the spectacled eider, *Somateria fischeri* (threatened); and bowhead whale (endangered). According to surveys the spectacled eider has recently nested in the vicinity of the Oliktok Point installation (Alaska Biological Research 1994). The bowhead whale may pass offshore of the installation during migration. The arctic peregrine falcon, *Falco peregrinus tundrius*, and gray whale, two previously listed species with potential to occasionally occur near the installation, were delisted by the U.S. Fish and Wildlife Service on 05 October 1994, and by the National Marine Fisheries Service on 16 June 1994, respectively.

1.2.7 Demographics

Approximately two contract personnel operate and maintain the Oliktok Point installation. The closest village is Nuiqsut, about 30 miles southwest of the installation with a population of approximately 354 (Alaska Department of Labor 1990). Air travel provides year-round access, as does a gravel road system that connects to the Prudhoe Bay/Deadhorse Area and the Dalton Highway. Seasonal marine transportation is provided by an Air Force contract carrier.

1.2.7.1 Cultural Resources. Historically, the area along Simpson Lagoon has been used for subsistence activities with yearly and seasonal variations influenced by the availability of resources (Hart Crowser 1987). Most of the cultural resources in the area are traditional sites identified as part of the Traditional Land Use inventories for Nuiqsut and mid-Beaufort Sea Region (Table 1-1). Few archeological surveys or excavations have been conducted in the area. A few early sites are known for this part of the Beaufort Sea coast. Although some of the known sites indicate that the region was occupied by native peoples about 500 years ago, earlier occupations are probable (Hoffman et al. 1978).

The Oliktok Point installation is within the subsistence use area of the village of Nuiqsut and also may be used by natives from as far as Kaktovik (NPRA Task Force 1979). Although subsistence studies have not been conducted for the area, available resources are known to include sea mammals, caribou, fish, and migratory waterfowl. Wentworth (1979) reported that sealing, caribou hunting, and fox trapping were practiced during the historic occupation of Oliktok. Hunting and trapping were noted for the area based on limited mapping of individual subsistence travels (NSB 1979).

1.2.7.2 Recreation. Very little recreational activity takes place in the area around Oliktok Point because of its isolated location and the extreme climatic conditions of the area. Access to the area is extremely limited, and there are no public accommodations. Recreational activities of residents of Nuiqsut and workers at Prudhoe Bay/Deadhorse focus on their villages and enclaves. Non-resident recreational activities are virtually non-existent near the Oliktok Point installation. The nearest areas for such activity are along the Colville River, where boat trips and some hiking and backpacking have been conducted, and at Prudhoe Bay where a limited amount of tourism occurs (NPRA Task Force 1978).

1.3 SITE INVENTORY

This section presents information on the IRP sites at the Oliktok Point radar installation. It includes summaries of previous IRP activities and remedial actions that have been conducted at the installation.

1.3.1 Sites at Oliktok Point

Eight sites at the Oliktok Point radar installation were investigated during the 1993 RI activities. One site, the Old Landfill (LF01), was determined to be of concern based on previous IRP sampling data. Additionally, seven sites were identified for investigation based on previous IRP activities and the 1993 RI activities as listed: literature search, pre-survey and reconnaissance trips, communication with personnel from Alaska Department of Environmental Conservation (ADEC), and information on disposal practices at DEW Line stations. The additional sites include the Dump Site (LF02), Dock Storage Area (ST03), POL Storage (ST04), Diesel Spill (SS05), Gasoline Storage Area (ST08), Garage (SS10), and Old Sewage Area Petroleum Spill (SS11). Prior to this RI/FS, no sampling had been conducted at these seven sites.

TABLE 1-1. KNOWN CULTURAL RESOURCE SITES IN THE VICINITY OF OLIKTOK POINT RADAR INSTALLATION[a]

SITE NAME	TLUI #[b] AHRS #	DESCRIPTION	LOCATION
Uliktuk	91 --	Ruins of cabin.	In the immediate vicinity of the Oliktok Point installation.
Ugrugnavik	95 --	Cabins, graves, sod house ruins; hunting/camping area.	About four miles east of the Oliktok Point installation.
Ugrugnavik River (Drew Point)	97 --	Cabins, graves, sod house ruins; hunting/camping area.	About five miles east of the Oliktok Point installation.
Mine Point	95 --	Cabins, graves.	About 10 miles east of the Oliktok Point installation.

a Data from Hoffman et al. 1978.
b TLUI = Traditional Land Use Inventory.
AHRS = Alaska Heritage Resources Survey.
Source: Hart Crowser 1987

It should be noted that none of the sites is on, or is proposed to be included on, the National Priority List (NPL) of Superfund sites.

1.3.2 Previous IRP Activities

An Air Force contractor conducted Phase I Installation Assessment/Records Search activities at the Oliktok Point installation and six other DEW Line stations in 1980 and 1981 (CH2M Hill 1981). Phase I activities included a detailed review of pertinent installation records from both government and civilian contractors, contacts with various government and private agencies for documents relevant to the program, and onsite visits during July and August 1981. The onsite visits included interviews with key installation employees, ground tours of installation facilities, and plane overflights to identify past disposal and possible contaminated areas.

An Air Force contractor conducted Phase II, Stages 1 and 2 Confirmation/Quantification activities in 1986. Phase II, Stage 1 activities involved field investigations of specific sites that were identified in the Phase I Installation Assessment/Records Search activities (Dames and Moore 1986). The Phase II, Stage 1 activities consisted of collecting a surface water sample at the Oliktok Point installation, Old Dump Site, Northwest (Dames and Moore 1986).

An Air Force contractor prepared a Technical Operations Plan for the Phase II, Stage 2 work in August 1986 (Dames and Moore 1987). The Phase II, Stage 2 activities involved field investigation of the Old Dump Site, Northwest, where two surface water samples were collected.

Analytical results and other observations were recorded in the Phase II, Stage 2 Draft Report released in August 1987 (Dames and Moore 1987).

An Air Force contractor released the final Technical Support Document for Record of Decision, Oliktok Point DEW Line site, in 1987 (Woodward-Clyde 1987). The Record of Decision, applicable to nine potential hazardous waste sites identified at the Oliktok Point installation, called for no further action with regard to investigation or cleanup, based on the assessment that there is no significant impact on human health or the environment from suspected or confirmed past contamination at the installation.

Correspondence from ADEC personnel to Air Force personnel in November 1991 disagreed with the no further action conclusion and stated that further investigation is needed and that corrective action appeared necessary because of improper waste disposal practices and other issues.

A contractor prepared an Environmental Assessment for the North Warning System (Alaska) (Hart Crowser 1987). Although not an IRP activity, the report discussed the impacts of retrofitting Long Range Radar (LRR) equipment at the Oliktok Point installation for use in the North Warning System program.

1.3.3 Previous Remedial Actions

There are no remedial actions taking place at this time, and there are no known remedial actions previously conducted at the Oliktok Point installation.

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2.0 PROJECT ACTIVITIES

This section of the report describes the project objectives and scope, the RI field program and methodology, the analytical programs, background sampling, and analytical results. In addition, data evaluation, risk estimate methodologies, potential migration pathways, and receptors are presented.

2.1 PROJECT OBJECTIVES AND SCOPE

The objectives of the Oliktok Point DEW Line radar installation RI/FS are to confirm the presence or absence of chemical contamination in the environment at the installation; define the extent and magnitude of confirmed chemical releases; gather adequate data to determine the magnitude of potential risks to human health and the environment; and gather adequate data to identify and select the appropriate remedial actions for sites where apparent risks exceed acceptable limits or contamination exceeds regulatory guidelines. The project objectives include the following goals:

- Define the horizontal and vertical extent of soil/sediment contamination and the range of contaminant concentration;

- Determine the physical and chemical properties of soil/sediment contaminants to describe contaminant toxicity and mobility;

- Define the extent of surface and active zone water contamination and the range of contaminant concentrations;

- Describe real and potential surface and subsurface contaminant migration pathways in terms of movement of dissolved and suspended contaminants through the active zone above permafrost, and movement of dissolved and suspended contaminants in surface water;

- Generate adequate valid data to support development of a baseline risk assessment that quantifies, to the extent possible, potential risks to human health and the environment posed by COCs at the Oliktok Point DEW Line installation studied under this RI; and

- Select the most feasible remedy, cleanup action, to reduce risks at sites where risks exceed acceptable limits.

2.2 RI FIELD ACTIVITIES

This section presents a summary of the field activities conducted during the RI, the organization of the RI field team, and the chronology of field work.

2.2.1 RI Field Program

The RI field program at the Oliktok Point radar installation was carried out in accordance with the RI/FS Work Plan, the Sampling and Analysis Plan, and the Health and Safety Plan (U.S. Air Force 1993a,b,c). These RI/FS planning documents were developed as specified in the Delivery Order No. 22 Statement of Work (Appendix C) and IRP Handbook (U.S. Air Force 1991).

The scope of the field investigation was described in detail in the Sampling and Analysis Plan (U.S. Air Force 1993b). The field activities included the following:

- Collecting and analyzing surface and subsurface soil samples and sediment samples from sites with potential or confirmed contamination. These samples were described and analyzed for petroleum and other chemical residues. Samples were collected using hand tools.

- Collecting and analyzing samples of surface water from potentially affected streams, surface water features such as lakes or ponds, and any apparent leachate discharge points.

- Collecting and analyzing background soil, sediment, and surface water samples to characterize natural background conditions.

- Measuring relative surface elevations of sampling points and stream channels to determine surface slopes and stream gradients.

- Collecting samples of potential chemical residues and waste materials at sites where such materials were suspected and had not yet been characterized.

- Conducting real-time air monitoring using portable field instruments.

- Measuring surface distances and approximate elevations to locate sampling points relative to fixed reference points.

The RI activities described above were carried out in three phases as follows:

- Installation Pre-Survey. The pre-survey was conducted by a small group of contractor employees (four total) accompanied by Air Force representatives. The purpose of the pre-survey was to confirm the location of areas of environmental concern at the installation. Pre-survey activities were limited to visual inspection of the sites, surface distance measurements, site photography, and confirmation of the location of structures and sites as shown on installation plan maps. The information gathered from the pre-survey was combined with existing documentation to support development of the RI/FS scoping documents. The pre-survey was completed at the Oliktok Point installation on 12 May 1993 by an Air Force contractor.

- Installation Reconnaissance. The installation reconnaissance was conducted by a group of contractor employees on 27 June 1993. The purpose of the reconnaissance was to identify sampling locations for investigation during the RI. The contractor staff made detailed observations of potentially contaminated areas and performed limited intrusive activities (e.g., digging shallow holes with a shovel to determine the apparent depth of contamination at areas of soil staining). Data gathered during the installation reconnaissance provided the basis for determining the sites to be sampled, the approximate number of samples and their locations, analyses for each sample, and equipment and supply needs for the RI.

- Remedial Investigation Field Activities. The RI field activities were conducted from mid-August through early September of 1993. The RI was conducted in conjunction with RIs at seven other radar installations located throughout northern Alaska. Fifteen contractor employees were stationed in Alaska for the duration of the RI. Sampling activities at the Oliktok Point radar installation included collection of surface and subsurface soil samples with hand tools (e.g., shovels, scoops, and bucket augers) and collection of surface water, sediment, and seep samples from potentially contaminated areas. The RI activities also included operation of temporary northern Alaska (Barrow, Alaska) laboratory facilities operated by a subcontractor.

2.2.2 Field Team Organization and Subcontractors

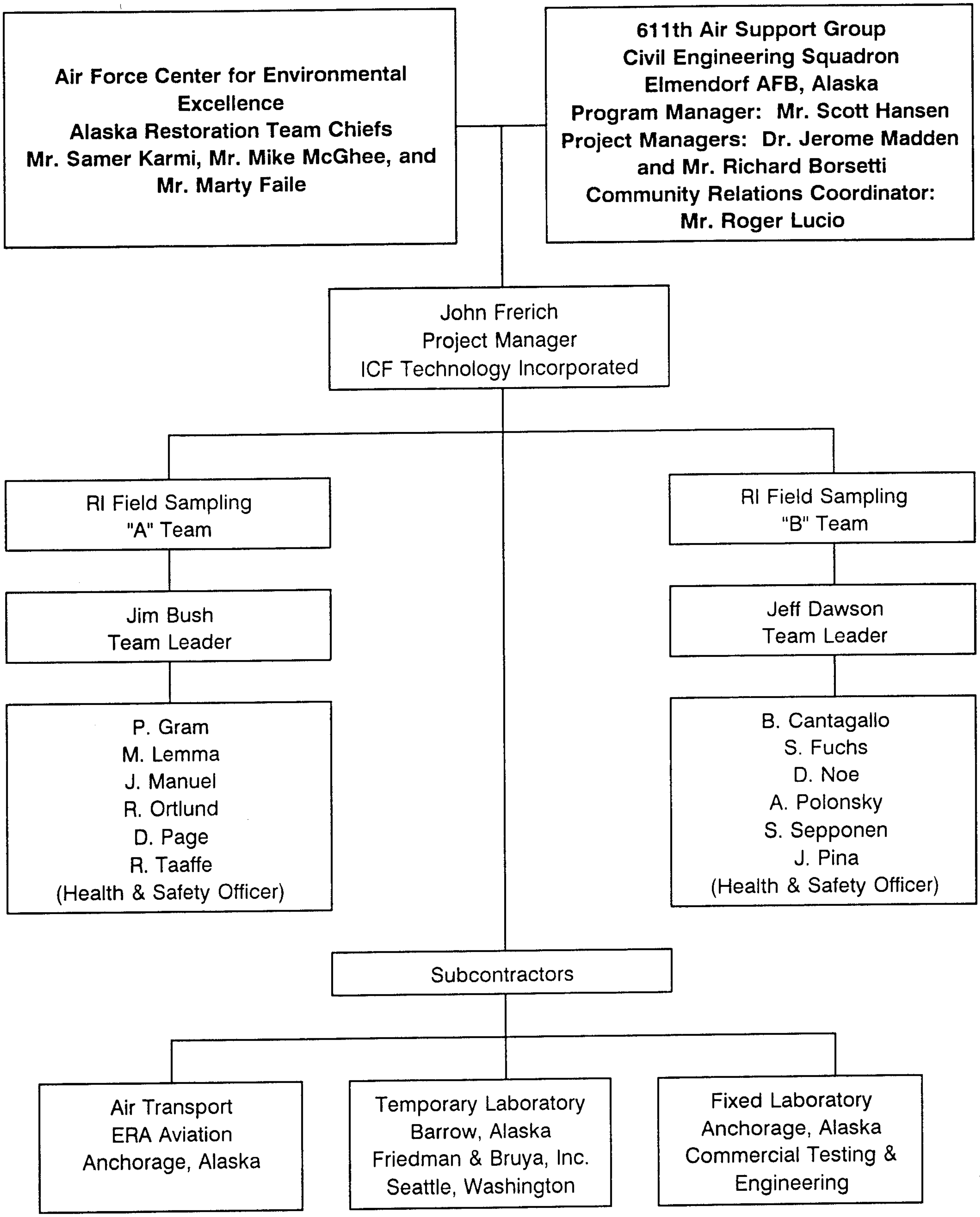
The organization of the RI field team, the responsibilities of the RI team members, and subcontractors used during RI activities are presented in Figure 2-1 (Note: all Oliktok Point sampling was conducted by the B RI Field Sampling Team). The AFCEE restoration team chiefs that managed and conducted oversight of the RI field activities included Mr. Marty Faile, Mr. Mike McGhee, and Mr. Samer Karmi.

2.2.3 Chronology of Field Work

The RI field work at the Oliktok Point radar installation conducted during summer 1993 was accomplished in the following chronological order:

12 May	Conducted onsite pre-survey
27 June	Conducted onsite reconnaissance
13 August	Staked 68 sampling locations at LF01, LF02, ST03, ST04, SS05, ST08, SS10, SS11, and background.
17 August	Mobilized equipment to site. Collected six soil samples and one water sample for background, seven soil and three water samples at SS05, and 2 QA/QC samples.

FIGURE 2-1. FIELD TEAM ORGANIZATION



18 August	Staked eight additional sampling locations at SS05. Collected one water sample at ST03, three soil samples at ST04, nine soil samples at SS05, nine soil and four water samples at SS11, and three QA/QC samples.
19 August	Collected six soil and three water samples at LF01, seven soil and one water sample at LF02, five soil samples at ST03, and two QA/QC samples.
20 August	Staked one additional sampling location at ST08 and five additional sampling locations at SS10. Collected 14 soil and 3 water samples at ST08, 12 soil and 1 water sample at SS10, 1 toxic characteristic leaching procedure (TCLP) waste sample, and 3 QA/QC samples.
3 September	Mobilized equipment to Oliktok for second round of sampling.
4 September	Staked 28 sampling locations at SS05, ST08, SS10, and SS11. Collected 3 soil samples at SS05, 14 samples at ST08, 4 soil samples at SS10, 7 soil samples at SS11, 1 TCLP waste sample, and 2 QA/QC samples.

2.3 RI SAMPLING AND ANALYSES

A summary of the RI sampling and analysis activities conducted during this investigation is presented in this section. Included are descriptions of the number of samples collected by media, QA/QC samples collected, background sampling and analyses, analytical programs, chronology of laboratory analyses, laboratory QA/QC programs, and data validation and reporting.

2.3.1 Sampling Procedures

Contractor personnel collected samples from various media at the Oliktok Point radar installation using numerous sample collection methods and procedures. The collection methods were determined at the time of collection, based on sample location and prevailing environmental conditions. Media sampled during the RI included surface and subsurface soils, surface water, and sediment. These media were extracted generally from man-emplaced fill, gravel pads, and scraped areas; and natural tundra soils/sediments and surface water bodies. All sampling tools or other devices used during sampling were decontaminated before use. Standard procedures, developed by the contractor for sampling methodologies used during the RI are presented in Appendix D of the RI/FS SAP (U.S. Air Force 1993b). Sample collection logs for all samples collected during RI activities at the Oliktok Point installation are presented in Appendix D. The logs provide detailed sample information such as media, location, depth, and analyses requested. Completed chain-of-custody forms for all samples collected during the RI at the Oliktok Point installation are presented in Appendix E.

2.3.2 Summary of RI Sampling

Contractor personnel collected 136 samples from various media at the Oliktok Point radar installation. Seven samples were collected to determine organic and inorganic background concentrations in soil/sediment and surface water. Twenty-seven samples were collected for quality assurance/quality control (QA/QC). QA/QC samples included duplicates, replicates, equipment rinsate blanks, trip blanks, ambient condition blanks, and investigation derived waste (IDW) samples. One hundred and two samples were collected to determine the nature and extent of contamination at the eight sites at Oliktok Point. Table 2-1 presents a summary of RI sampling conducted at Oliktok Point.

2.3.2.1 Field QA/QC Samples. The field QA/QC program consisted of QA/QC samples, quality control (QC) checks, and limits for field procedures.

QA/QC Samples. QA/QC samples collected during this investigation included duplicate water samples, replicate soil/sediment samples, trip blanks, ambient condition blanks, and equipment rinsate blanks.

During RI sampling activities at the Oliktok Point installation, QA/QC samples collected included the following: 1 duplicate water sample, 11 replicate soil/sediment samples, 6 trip blanks, 2 ambient condition blanks, 5 equipment rinsate blanks, and 2 IDW samples. Table 2-2 summarizes all samples collected and analyzed during RI activities at the Oliktok Point installation, including the QA/QC samples.

In addition to the above QA/QC samples, extra volumes of selected samples were collected and submitted for internal laboratory QA/QC (matrix spike and matrix spike duplicates). Extra sample volumes were submitted at a minimum of 1 per 10 samples. Extra volumes submitted included triple volume for organic water analyses and double volume for inorganic water analyses.

2.3.2.2 Background Sampling and Analyses. Seven background samples were collected from upgradient areas during field activities at the Oliktok Point radar installation to establish background concentrations for naturally occurring organic compounds. In order to obtain a representative range of inorganic (metal) concentrations in soil/sediments and surface waters of the North Slope, 44 samples (29 soil/sediment and 15 water) from seven North Slope radar installations were collected. The seven installations include Barter Island, Bullen Point,

TABLE 2-1. SUMMARY OF OLIKTOK POINT REMEDIAL INVESTIGATION FIELD SAMPLING ACTIVITIES

ACTIVITY	TOTAL
Water Samples Collected for Lab Analyses (includes QA/QC)	32 samples
Soil/sediment Samples Collected for Lab Analyses (including QA/QC)	104 samples
TOTAL WATER AND SOIL SAMPLES FOR LAB ANALYSES	136 samples

1

TABLE 2-2. SUMMARY OF SAMPLING AND ANALYSES CONDUC

ANALYSES	HVOC*	VOC 8010	BTEX*	VOC 8260	SVOC	Metals[b]	TPH-Diesel[b] Range 3510/3550	TPH - C Ra
ANALYTICAL METHOD	SW8010M	SW8010M	SW8020	SW8260	SW8270	SW3050 (Soil) 3005 (Water)/6010	Diesel 8100M	Gas 503
OLIKTOK POINT								
Background	NA	5 Soil 1 Water	5 Soil 2 Water	5 Soil 2 Water	5 Soil 2 Water	5 Soil 2 Water (Total) 2 Water (Dissolved)	5 Soil 2 Water	5 2 W
Old Landfill (LF01)	6 Soil 3 Water	NA	6 Soil 3 Water	2 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water (Total) 1 Water (Dissolved)	6 Soil 3 Water	6 3 W
Dump Site (LF02)	5 Soil 1 Water	NA	5 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water (Total) 1 Water (Dissolved)	5 Soil 1 Water	5 1 W
Dock Storage Area (ST03)	4 Soil	1 Water	4 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water	1 Water (Total) 1 Water (Dissolved)	4 Soil 1 Water	4 1 W
POL Storage (ST04)	NA	NA	3 Soil	1 Soil	NA	NA	3 Soil	3
Diesel Spill (SS05)	NA	NA	14 Soil 2 Water	1 Soil 1 Water	1 Soil 1 Water	NA	16 Soil 2 Water	14 2 W
Gasoline Storage Area (ST08)	13 Soil 3 Water	NA	16 Soil 3 Water	3 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water (Total) 1 Water (Dissolved)	26 Soil 3 Water	16 3 W
Garage (SS10)	11 Soil	NA	11 Soil 1 Water	4 Soil 1 Water	1 Soil 1 Water	1 Soil 1 Water (Total) 1 Water (Dissolved)	14 Soil 1 Water	11 1 W
Old Sewage Outfall Petroleum Spill (SS11)	NA	8 Soil 3 Water	10 Soil 3 Water	2 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water (Total) 1 Water (Dissolved)	14 Soil 3 Water	10 3 W
Total Field Analyses	39 Soil 7 Water	13 Soil 5 Water	74 Soil 16 Water	22 Soil 9 Water	17 Soil 9 Water	14 Soil 8 Water (Total) 8 Water (Dissolved)	93 Soil 16 Water	74 16
QA/QC SAMPLES								
Trip Blanks	3 Water	2 Water	5 Water	6 Water	NA	NA	NA	3 W
Equipment Blanks	2 Water	2 Water	5 Water	5 Water	4 Water	4 Water (Total) 1 Water (Dissolved)	3 Water	5 W
Ambient Condition Blanks	NA	1 Water	1 Water	2 Water	NA	NA	NA	I
Field Replicates	5 Soil	1 Soil	8 Soil	3 Soil	2 Soil	2 Soil	11 Soil	8
Field Duplicates	NA	1 Water	1 Water	1 Water	1 Water	1 Water (Total) 1 Water (Dissolved)	1 Water	1 W
Investigation Derived Wastes (IDW)	NA	NA	NA	2 Water	NA	1 Water (Total)	2 Water	I

NA Not analyzed.
* These analyses were completed on a quick turnaround basis.
[a] The number of soil sample includes sediment samples collected from surface water features.
[b] Some of these analysis were completed on a 24-hour turnaround at a temporary fixed laboratory at Barrow, Alaska.
[d] Investigation derived wastes from Oliktok Point were combined with the investigation derived wastes from Bullen Point. These we

-2

\NALYSES CONDUCTED FOR OLIKTOK POINT REMEDIAL INVESTIGATIONS[a]

TPH-Diesel[b] Range 3510/3550	TPH - Gasoline[b] Range	TPH Residual Range*	PCB*	Pesticides*	TDS	TSS	TOC	TCLP[d]	TOTAL SAMPLE
Diesel 8100M	Gas 5030/8015M	Diesel 8100M	SW8080/8080M	SW8080/8080M	E160.1	E160.2	SW9060	SW1311	
5 Soil 2 Water	5 Soil 2 Water	NA	5 Soil 2 Water	5 Soil 2 Water	2 Water	2 Water	2 Water	NA	5 Soil 2 Wate
6 Soil 3 Water	6 Soil 3 Water	6 Soil 3 Water	6 Soil 3 Water	NA	1 Water	1 Water	1 Water	NA	6 Soil 3 Wate
5 Soil 1 Water	5 Soil 1 Water	5 Soil 1 Water	5 Soil 1 Water	NA	1 Water	1 Water	1 Water	NA	5 Soil 1 Wate
4 Soil 1 Water	4 Soil 1 Water	4 Soil	4 Soil 1 Water	1 Water	1 Water	1 Water	1 Water	NA	4 Soil 1 Wate
3 Soil	3 Soil	NA	NA	NA	NA	NA	NA	NA	3 Soil
16 Soil 2 Water	14 Soil 2 Water	3 Soil	NA	NA	1 Water	1 Water	1 Water	NA	16 Soi 2 Wate
26 Soil 3 Water	16 Soil 3 Water	26 Soil 3 Water	13 Soil 3 Water	2 Soil	1 Water	1 Water	1 Water	NA	26 Soi 3 Wat
14 Soil 1 Water	11 Soil 1 Water	14 Soil 1 Water	11 Soil	NA	NA	NA	NA	NA	14 Soi 1 Wate
14 Soil 3 Water	10 Soil 3 Water	6 Soil	8 Soil 3 Water	2 Soil 1 Water	1 Water	1 Water	1 Water	NA	14 Soi 3 Wate
93 Soil 16 Water	74 Soil 16 Water	64 Soil 8 Water	52 Soil 13 Water	9 Soil 4 Water	8 Water	8 Water	8 Water	NA	93 Soi 16 Wat
NA	3 Water	NA	NA	NA	NA	NA	NA	NA	6 Wate
3 Water	5 Water	2 Water	3 Water	2 Water	NA	NA	NA	NA	5 Wate
NA	NA	NA	NA	NA	NA	NA	NA	NA	2 Wate
11 Soil	8 Soil	8 Soil	6 Soil	1 Soil	NA	NA	NA	NA	11 So
1 Water	1 Water	NA	1 Water	NA	1 Water	1 Water	1 Water	NA	1 Wate
2 Water	NA	2 Water	2 Water	1 Water	NA	NA	NA	2 Water	2 Wate

row, Alaska.
›m Bullen Point. These were collectively sampled during the Oliktok Point investigation.

(3)

S[a]

TSS	TOC	TCLP[d]	TOTAL SAMPLES
E160.2	SW9060	SW1311	
2 Water	2 Water	NA	5 Soil 2 Water
1 Water	1 Water	NA	6 Soil 3 Water
1 Water	1 Water	NA	5 Soil 1 Water
1 Water	1 Water	NA	4 Soil 1 Water
NA	NA	NA	3 Soil
1 Water	1 Water	NA	16 Soil 2 Water
1 Water	1 Water	NA	26 Soil 3 Water
NA	NA	NA	14 Soil 1 Water
1 Water	1 Water	NA	14 Soil 3 Water
8 Water	8 Water	NA	93 Soil 16 Water
NA	NA	NA	6 Water
NA	NA	NA	5 Water
NA	NA	NA	2 Water
NA	NA	NA	11 Soil
1 Water	1 Water	NA	1 Water
NA	NA	2 Water	2 Water

(1)

TABLE 2-2. SUMMARY OF SAMPLING AND ANALYSES CONDUCTED F(

ANALYSES	HVOC*	VOC 8010	BTEX*	VOC 8260	SVOC	Metals[b]	TPH-Diesel[b] Range 3510/3550	TPH - (Ra
ANALYTICAL METHOD	SW8010M	SW8010M	SW8020	SW8260	SW8270	SW3050 (Soil) 3005 (Water)/6010	Diesel 8100M	Gas 503
Total Site Analyses	44 Soil 12 Water	14 Soil 11 Water	82 Soil 28 Water	25 Soil 25 Water	19 Soil 14 Water	16 Soil 14 Water (Total) 10 Water (Dissolved)	104 Soil 22 Water	82 25 \

NA Not analyzed.
* These analyses were completed on a quick turnaround basis.
a The number of soil sample includes sediment samples collected from surface water features.
b Some of these analysis were completed on a 24-hour turnaround at a temporary fixed laboratory at Barrow, Alaska.
d Investigation derived wastes from Oliktok Point were combined with the investigation derived wastes from Bullen Point. These we

(2)

ES CONDUCTED FOR OLIKTOK POINT REMEDIAL INVESTIGATIONS[a] (CONTINUED)

TPH-Diesel[b] Range 3510/3550	TPH - Gasoline[b] Range	TPH Residual Range*	PCB*	Pesticides*	TDS	TSS	TOC	TCLP[d]	TOTAL SAMPLE:
Diesel 8100M	Gas 5030/8015M	Diesel 8100M	SW8080/8080M	SW8080/8080M	E160.1	E160.2	SW9060	SW1311	
104 Soil 22 Water	82 Soil 25 Water	72 Soil 12 Water	58 Soil 19 Water	10 Soil 7 Water	9 Water	9 Water	9 Water	2 Water	104 Soil 32 Wate

ow, Alaska.
n Bullen Point. These were collectively sampled during the Oliktok Point investigation.

3

TINUED)

TSS	TOC	TCLP[d]	TOTAL SAMPLES
E160.2	SW9060	SW1311	
9 Water	9 Water	2 Water	104 Soil 32 Water

Oliktok Point, Point Lonely, Point Barrow, Wainwright, and Point Lay. Approximately five soil/sediment and two surface water background samples were collected from each of these installations to determine the background concentrations of inorganic analytes across similar coastal arctic environments of the North Slope.

Seven background samples were collected from tundra and ponds during the RI at Oliktok Point. These consisted of four soil, one sediment, and two surface water samples.

Five background soil/sediment samples were analyzed for DRPH, GRPH, BTEX, halogenated volatile organic compounds (HVOCs), VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), and metals.

Two background surface water samples were analyzed for DRPH, GRPH, BTEX, HVOCs, VOCs, SVOCs, pesticides, PCBs, total organic carbon (TOC), total suspended solids (TSS), total dissolved solids (TDS), and total and dissolved metals.

Data Summary. Background sample locations at Oliktok Point are illustrated in Figure 2-2. The data summary table (Table 2-3) presents analytical results for all background samples collected at Oliktok Point. Detection and quantitation limits, action levels, and the associated field and laboratory blank results are included on the data summary table.

Below is a discussion of organic compounds and inorganic analytes detected in background samples at Oliktok Point. A discussion of TDS, TSS, and TOC is included. Analytical results are presented in Table 2-3 and Figure 2-2.

Organics. Only DRPH were detected in background soil and sediment samples. DRPH were detected in all five of the background soil and sediment samples at concentrations ranging from 13.8 to 167 mg/kg. DRPH are assumed to be the result of naturally occurring biogenic hydrocarbons; DRPH in background samples were identified by the laboratory as not being consistent with middle distillate fuels. Although some naturally occurring compounds were detected in the DRPH analyses of some of the soil/sediment background samples, the organic concentration in background samples is assumed to be non-detect. This conservative approach was used because it is not possible to determine what degree, if any, the DRPH detected in site samples were naturally occurring compounds. In addition, DRPH were detected in both surface water samples, BKGD-SW01 and BKGD-SW02, at concentrations of 392 and 457 mg/L, respectively. The DRPH in surface water were also noted by the laboratory as being inconsistent with a middle distillate fuel and were probably of biogenic origin. The range of background concentrations detected for all analytes are presented in data summary table for each of the eight sites presented in Sections 3.0 and 4.0.

Inorganics. Sixteen metals were detected in background soil and sediment samples at Oliktok Point. Five metals were detected in background surface water samples collected at Oliktok Point. The results of background inorganic analyses are presented in Table 2-3.

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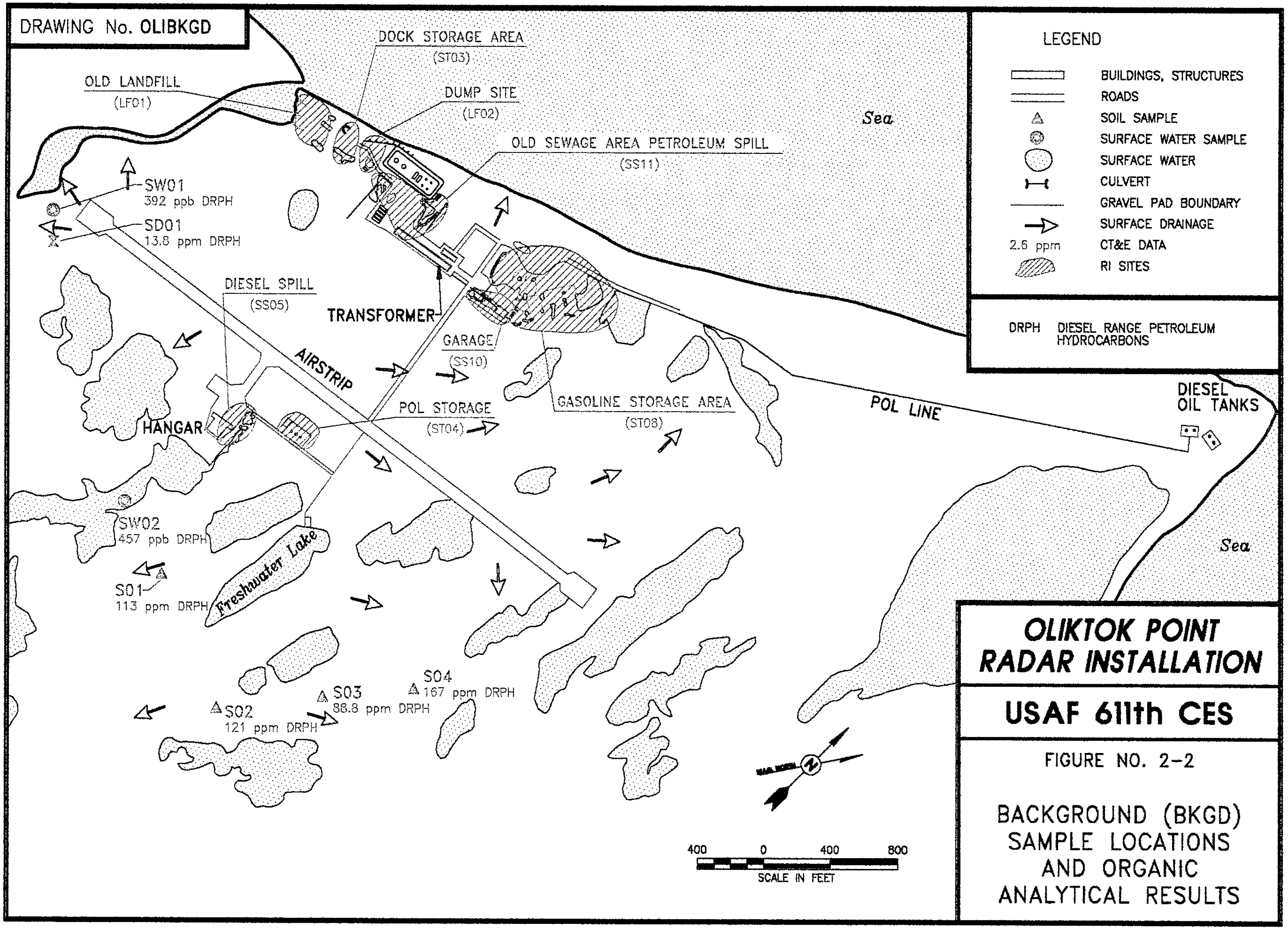

OLIKTOK POINT RADAR INSTALLATION

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FIGURE NO. 2-2

BACKGROUND (BKGD) SAMPLE LOCATIONS AND ORGANIC ANALYTICAL RESULTS

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TABLE 2-3 BACKGROUND ANALYTICAL DATA SUMMARY

Installation: Oliktok Point
Site: Background (BKGD)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01	S02	S03	S04	SD01	AB01	EB01	TB01		
Laboratory Sample ID Numbers					4176-1 4280-1	4176-2 4280-4	4176-3 4280-7	4176-4 4280-8	4176-5 4280-9	4209-7 4214-6	4172-1 4174-2 4279-2	4174-1 4279-1	4174 4279 4209 4214	4176 4280
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	13.8J-167J	113[d]	121[d]	88.8[d]	167J[d]	13.8J[d]	NA	<200	NA	<200	<4.0
GRPH	0.400	0.600-1.00	100	<0.600-<1.00	<0.800	<0.600	<0.600	<0.800	<1.00	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.250	<0.150	<0.150	<0.200	<0.300					
Benzene	0.020	0.030-0.060	0.5	<0.030-<0.060	<0.050	<0.030	<0.030	<0.040	<0.060	<1	<1	<1	<1	<0.020
Toluene	0.020	0.030-0.060		<0.030-<0.060	<0.050	<0.030	<0.030	<0.040	<0.060	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.030-0.060		<0.030-<0.060	<0.050	<0.030	<0.030	<0.040	<0.060	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.060-0.120		<0.060-<0.120	<0.100	<0.060	<0.060	<0.080	<0.120	<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.030-0.060		<0.030-<0.060	<0.050	<0.030	<0.030	<0.040	<0.060	<1	<1	<1	<1	<0.020
VOC 8260	0.020	0.030-0.045		<0.030-<0.045	<0.040	<0.035	<0.040	<0.030	<0.045	<1	<1-1	<1	<1	<0.020
SVOC 8270	0.200	0.330-3.30		<0.330-<3.30	<3.30	<2.80	<2.80	<2.70	<0.330	NA	<10.1	NA	<10	<0.200
Pesticides	0.001	0.005-0.100		<0.005-<0.100	<0.008-<0.080	<0.005-<0.090	<0.005-<0.030	<0.005J-<0.030J	<0.010-<0.100	NA	<0.1-<2	NA	<0.1-<2	<0.005
PCBs	0.020	0.030-0.100	10	<0.030-<0.100	<0.080	<0.030	<0.030	<0.030J	<0.100	NA	<2	NA	<2	<0.020

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
d The laboratory reported the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Background (BKGD)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Levels	Environmental Samples S01	S02	S03	S04	SD01	Field Blank EB01	Lab Blanks
Laboratory Sample ID Numbers						4176-1	4176-2	4176-3	4176-4	4176-5	4172-2	4176 4172
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	1,800-15,000	11,000	15,000	12,000	8,400	1,800	<100	<100
Antimony	N/A	66-85		<7.8-<230	<66-<85	<81	<71	<71	<66R	<85R	<100	<100
Arsenic	0.11	2-8.1		<4.9-8.5	<6.6-8.5	<8.1	<7.1	<7.1	<6.6	8.5	<100	<100
Barium	0.024	1		27-390	66-280	280	200	240	190	66	<50	<50
Beryllium	N/A	1-4.3		<2.6-6.4	<4.3-6.4	5.7	6.4	4.4	4.0	<4.3	<50	<50
Cadmium	0.33	1		<3.0-<36	<3.3-4.4	4.4	<36	<3.6	<3.3	<4.3	<50	<50
Calcium	0.69	4		360-59,000	1,500-5,600	5,600	2,500	5,200	4,000	1,500	250	<200
Chromium	0.066	1-4.3		<4.3-47	<4.3-21	16	21	18	14J	<4.3J	<50	<50
Cobalt	N/A	1-8.5		<5.1-12	<6.5-11	11	7.1	<6.5	<6.6	<8.5	<100	<100
Copper	0.045	1-41		<2.7-45	<4.3-7.4	<41	7.4	<9.8	<8.1	<4.3	<50	<50
Iron	0.50	2		5,400-35,000	7,600-27,000	23,000	27,000	18,000	16,000	7,600	380	<100
Lead	0.13	66-71		<5.1-22	<6.6-<71	<8.1	<71	<7.1	<6.6	<8.5	<100	<100
Magnesium	0.96	4		360-7,400	610-2,900	2,200	2,900	2,400	2,100	610	<200	<200
Manganese	0.025	1		25-290	51-280	280	180	210	51	110	<50	<50
Molybdenum	N/A	3.3-4.3		<2.5-<11	<3.3-<4.3	<4.1	<3.6	<3.6	<3.3	<4.3	<50	<50
Nickel	0.11	1		4.2-46	5.8-16	16	15	16	13	5.8	<50	<50
Potassium	23	100-420		<300-2,200	<420-1,300	1,000	1,300	1,100	750	<420	<5,000	<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.
R Result has been rejected.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point   Matrix: Soil/Sediment   METALS ANALYSES
Site: Background (BKGD)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Levels	Environmental Samples						Field Blank			Lab Blanks
						S01	S02	S03	S04	SD01			EB01		
Laboratory Sample ID Numbers						4176-1	4176-2	4176-3	4176-4	4176-5			4172-2		4176 4172
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L		µg/L
Selenium	1.2	66-85		<7.8-170	<66-<85	<81	<71	<71	<66	<85			<100		<100
Silver	0.53	3.3-4.3		<3-<110	<3.3-<4.3	<4.1	<3.6	<3.6	<3.3	<4.3			<50		<50
Sodium	0.55	5		<160-680	55-220	220	200	190	150	55			480		NA
Thallium	0.011	0.33-0.41		<0.2-<1.2	<0.33-0.41	<0.41	<0.35	<0.35	<0.33	<0.41			<5		<5
Vanadium	0.036	1		6.3-59	6.3-37	30	37	30	25	6.3			<50		<50
Zinc	0.16	1		9.2-95	17-50	36	50	33	30	17			<50		<50

☐ CT&E Data.
NA Not analyzed

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02				AB01	EB01	TB01	
Laboratory Sample ID Numbers					4174-3 4279-3	4174-4 4279-6				4209-7 4214-6	4172-1 4174-2 4279-2	4174-1 4279-1	4279 4174 4214
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L	µg/L	µg/L
DRPH	100	100		392^{ad}-$457J^{ad}$	392^{ad}	$457J^{ad}$				NA	<200	NA	<200
GRPH	20	20		<20	<20	<20				NA	<20	NA	<20
BTEX (8020/8020 Mod.)													
Benzene	1	1	5	<1	<1	<1				<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	<1				<1	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	<1				<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	<2				<2	<2	<2	<2
VOC 8010	1	1		<1	<1	NA				<1	<1	<1	<1
VOC 8260	1	1		<1	<1	<1				<1	<1-1	<1	<1
SVOC 8270	10	10		<10	<10	<10J				NA	<10.1	NA	<10
Pesticides	0.005	0.1-2		<0.1-<2	<0.1-<2	<0.1-<2				NA	<0.1-<2	NA	<0.1-<2
PCBs	1	1-2	0.5	<1-<2	<2	<1-<2				NA	<2	NA	<1-<2
TOC	5,000	5,000		6,700-14,400	6,700	14,400				NA	NA	NA	<5,000
TSS	100	200		6,000-9,000	6,000	9,000				NA	NA	NA	<200
TDS	10,000	10,000		212,000-352,000	212,000	352,000				NA	NA	NA	12,000

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Levels	Environmental Samples					Field Blank			Lab Blanks
						SW01	SW02					EB01		
Laboratory Sample ID Numbers						4174-3	4174-4					4172-2		4174 4172
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)	<100 (<100)	<100 (<100)					<100		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	58-93 (57-91)	58 (57)	93 (91)					<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	34,000-38,000 (34,000-38,000)	34,000 (34,000)	38,000 (38,000)					250		<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Iron	25	100		180-2,800 (<100- 1,600)	210-440 (120-150)	210 (120)	440 (150)					380		<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100		<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point   Matrix: Surface Water   METALS ANALYSES: TOTAL
Site: Background (BKGD)   Units: µg/L   (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Levels	Environmental Samples					Field Blank			Lab Blanks
						SW01	SW02					EB01		
Laboratory Sample ID Numbers						4174-3	4174-4					4172-2		4174 4172
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	4,100-10,000 (4,000-11,000)	4,100 (4,000)	10,000 (11,000)					<200		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Potassium	1,154	5,000		<5,000 (5,000)	<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)					<5,000		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	15,000-43,000 (15,000-49,000)	15,000 (15,000)	43,000 (44,000)					480		<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)	<5 (<5)					<5		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50		<50 (<50)

☐ CT&E Data.
N/A Not available.

TOC was reported at 6,700 and 14,400 μg/L in surface water samples BKGD-SW01 and BKGD-SW02, respectively. TSS were detected at 6,000 and 9,000 μg/L, and TDS were detected at 212,000 and 352,000 μg/L in the same respective samples.

2.3.3 Laboratory Analyses

This section describes the RI analytical program. Summaries of the soil/sediment and water analyses conducted during the RI are presented in Tables 2-4 and 2-5. Table 2-4 presents a description of the soil analytical methods and number of soil samples collected, and Table 2-5 presents a description of the water analytical methods and the number of water samples collected during the RI.

2.3.3.1 Analytical Program. Analyses of samples were conducted by a fixed laboratory in Anchorage, Alaska, and a temporary laboratory set up at Barrow, Alaska. The analytical testing conducted by each laboratory is discussed below.

The fixed laboratory in Anchorage, Alaska, was operated by Commercial Testing & Engineering (CT&E). CT&E analyzed samples as follows:

Analyses	Analytical Method
Volatile Organic Compounds	SW5030/8260
Metals	SW3050 (Soil) 3005 (Water)/6010
Semi-Volatile Organic Compounds	SW3550 (Soil) 3510 (Water)/8270
Total Dissolved Solids	E160.1
Total Suspended Solids	E160.5
Total Organic Carbon	SW9060
Moisture Content	ASTM D 2216
Toxicity Characteristic Leaching Procedure (TCLP)	SW1311

In addition, for the first few weeks of the field activities, CT&E provided the following analyses on a quick turnaround basis:

Analyses	Analytical Method
Halogenated Volatile Organic Compounds	SW5030/8010
Benzene, Toluene, Ethylbenzene, and Xylenes	SW5030/8020
Gasoline Range Petroleum Hydrocarbons (GRO)	8015 Modified
Diesel Range Petroleum Hydrocarbons (DRO)	8100 Modified
Polychlorinated Biphenyls/Pesticides	SW5030/8080

The temporary laboratory in Barrow, Alaska, was operated by Friedman & Bruya (F&B) of Seattle. F&B analyzed samples for the following constituents:

TABLE 2-4. ANALYTICAL METHODS AND TOTAL NUMBER OF SOIL ANALYSES

SOIL ANALYSES[a]	ANALYTICAL METHOD	REPORTING UNITS	NUMBER OF ANALYSES	REPLICATES	TOTAL ANALYSES
Volatile Organics	SW5030/8260	mg/kg	22	3	25
Semi-Volatile Organics	SW3550/8270	mg/kg	17	2	19
Total Metals Analysis --ICP Screen	SW3050/6010	mg/kg	14	2	16
TPH - Diesel Range	SW3510/3550/8100M	mg/kg	93	11	104
TPH - Gasoline Range	SW5030/8015M	mg/kg	74	8	82
TPH - Residual Oil	SW3510/3550/8100M	mg/kg	64	8	72
BTEX	SW5030/8020/8020M	mg/kg	74	8	82
VOC 8010	SW5030/8010	mg/kg	13	1	14
Halogenated Volatile Organic Compounds	SW5030/8010M	mg/kg	39	5	44
PCB	SW5030/8080/8080M	mg/kg	52	6	58
Pesticides	SW5030/8080/8080M	mg/kg	9	1	10
TOTAL SOIL ANALYSES			471	55	526
TOTAL SOIL SAMPLES			93	11	104

N/A Not applicable.
[a] Includes soil and sediment samples.
M Modified.

TABLE 2-5. ANALYTICAL METHODS AND TOTAL NUMBER OF WATER ANALYSES

WATER ANALYSES	ANALYTICAL METHOD	REPORTING UNITS	NUMBER OF ANALYSES	TRIP BLANKS	AMBIENT CONDITION BLANKS	EQUIPMENT BLANKS	DUPLICATES	TOTAL ANALYSES
Volatile Organics	SW5030/8260	µg/L	11	6	2	5	1	25
Semi-Volatile Organics	SW3550/8270	µg/L	9	0	0	4	1	14
Total Metals Analysis --ICP Screen	SW3005/6010	µg/L	9	0	0	4	1	14
Dissolved Metals Analysis --ICP Screen	SW3005/6010	µg/L	8	0	0	1	1	10
TOC, Nonpurgable	SW9060	µg/L	8	0	0	0	1	9
Residue, Filterable (TSS)	E 160.2	µg/L	8	0	0	0	1	9
Residue, Filterable (TDS)	E 160.1	µg/L	8	0	0	0	1	9
TPH - Diesel Range	SW3510/3550/8100M	µg/L	18	0	0	3	1	22
TPH - Gasoline Range	SW5030/8015M	µg/L	16	3	0	5	1	25
TPH - Residual Oil	SW3510/3550/8100M	µg/L	10	0	0	2	0	12
BTEX	SW5030/8020/8020M	µg/L	16	5	1	5	1	28
VOC 8010	SW5030/8010	µg/L	5	2	1	2	1	11
Halogenated Volatile Organic Compounds	SW5030/8010M	µg/L	7	3	0	2	0	12
PCB	SW5030/8080/8080M	µg/L	15	0	0	3	1	19
Pesticides	SW5030/8080/8080M	µg/L	5	0	0	2	0	7
TCLP	SW1311	µg/L	2	0	0	0	0	2
TOTAL WATER ANALYSES			155	19	4	38	12	228
TOTAL WATER SAMPLES			18	6	2	5	1	32

M Modified.

Analyses	Analytical Method
Halogenated Volatile Organic Compounds (four compounds only)	SW5030/8010 Modified
Benzene, Toluene, Ethylbenzene, and Xylenes	SW5030/8020 Modified
Polychlorinated Biphenyls/Pesticides	SW3550/8080 Modified
Diesel Range Organics	8100 Modified
Gasoline Range Organics	8010/8020/8015 Modified
Residual Range Organics	8100 Modified

Analytical methods used during sample analyses for this project are summarized in Tables 2-4 and 2-5 and are developed from the reference methods described in the following sources:

- *Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)* Third Edition, EPA SW-846. September 1986.

- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020. March 1983.

- *Standard Methods for the Examination of Water and Wastewater*, APHA/AWWA, 17th Edition. 1989.

- *Interim Guidance for Non-UST Soil Cleanup Levels*, Alaska Department of Environmental Conservation, July 1991.

Project-specific analytical methods and procedures, target analytes, quantitation limits, and acceptance criteria are presented in the RI/FS SAP (U.S. Air Force 1993b).

2.3.4 Chronology of Laboratory Analyses

Laboratory analyses conducted by the temporary laboratory, F&B, in Barrow, Alaska, were conducted on a quick-turnaround basis. The samples collected at Oliktok Point radar installation were analyzed by this laboratory during the period from 14 August to 11 September 1993.

Analyses at the CT&E laboratory in Anchorage, Alaska, were conducted between 16 August and 15 October 1993. These analyses included a few quick-turnaround analyses but primarily standard-turnaround analyses.

2.3.5 Laboratory QA/QC Programs

The quality assurance (QA) objectives for this project were achieved through implementation of specific procedures for sampling, chain-of-custody, calibration, laboratory analyses, data validation and reporting, internal QC, audits, preventive maintenance, and corrective actions.

A detailed description of QA/QC measures, frequency, and corrective actions used by both labs is presented in the Quality Assurance Project Plan (QAPjP) [Section 1 of the RI/FS SAP (U.S. Air Force 1993b)]. Ultimately, the relevant laboratory standard operating procedures (SOPs) provide

full and detailed guidance regarding all method-specific laboratory QA/QC criteria and appropriate corrective actions.

Data quality for the organic analyses was monitored by the laboratory through a QA program that included analyses of initial and continuing calibrations, method blanks, surrogate spikes, internal standards, matrix spikes, matrix spike duplicates, and laboratory control samples. The identification of target analytes at levels above the detection limit was confirmed by gas chromatography/mass spectrometry (GC/MS) or analysis on a gas chromatograph (GC) equipped with a different column (second column confirmation).

Data quality for the inorganic analyses was monitored through a QC program that included analyses of initial and continuing calibrations, laboratory control samples, method blanks, duplicate samples, post-digestion analytical spikes, and matrix spikes.

Laboratory QC samples were analyzed at a rate of at least one per 20 determinations. See the RI/FS QAPjP for laboratory-specific criteria for the frequency of QC sample analyses and corrective actions regarding QC analyses.

2.3.6 Data Validation and Reporting

Data validation is a systematic process of reviewing a group of sample data to provide assurance that the data are adequate for their intended use. The validation activities were performed in accordance with the following EPA documents to the extent that they were applicable:

- *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses*. EPA. Hazardous Site Evaluation Division. December 1990.

- *Laboratory Data Validation Guidelines for Evaluating Inorganic Analyses*. EPA. Hazardous Site Evaluation Division. October 1989a.

- *Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)* Third Edition, EPA SW-846. September 1986.

Prior to releasing data for use by project staff, selected data packages underwent a formal validation procedure to examine laboratory compliance with QA requirements and other factors that determine the quality of the data. The organic validation was performed by the prime contractor in accordance with the EPA Functional Guidelines for Evaluating Organic Analyses. The following factors were examined:

- Sample holding times;
- Sample chain-of-custody;
- GC/MS tuning criteria;
- Initial and continuing calibration;
- Method blanks;
- Practical quantitation limits;
- Laboratory blank contamination;

- Surrogate spike recoveries;
- Matrix spike/duplicate analysis;
- Field duplicate analysis;
- Ambient condition blank contamination;
- Trip blank contamination;
- Internal standard area;
- Pesticide instrument performance;
- Compound identification criteria; and
- Analyte identification and quantitation.

The inorganic data validation was performed in accordance with the EPA Functional Guidelines for Evaluating Inorganic Analyses. Parameters evaluated include:

- Holding time;
- Blank results;
- Instrument calibration;
- Inductively coupled plasma (ICP) spectroscopy interference check analysis;
- Laboratory control samples;
- Duplicate analysis;
- Spike analyses;
- Furnace analyses (spikes and duplicates);
- Serial dilution;
- Detection limits; and
- Analyte quantitation.

When a data package was received from the laboratory, the analytical results and associated QA/QC documentation were reviewed for technical compliance, and data validation reports were prepared summarizing the QA/QC parameters that were reviewed. The review included evaluation of laboratory and field blank sample data, and review of all data for accuracy, precision, and completeness.

A cross-section of CT&E analytical data, representing approximately 15 percent of all the CT&E analyses, underwent formal data validation. Because some reporting errors were found in the F&B analytical data, 100 percent of the F&B data was validated. Once the validation for a batch of samples was completed, a validation report was prepared. The report highlights all the QC criteria evaluated, and notes any major deficiencies or QA problems. Although a minimal amount of analytical data was rejected during data evaluation, the acceptable and valid data from CT&E and F&B are sufficient to meet the project objectives. The data validation reports for data generated by CT&E and F&B are presented in Appendix G.

2.4 METHODOLOGY FOR RISK ESTIMATION

This section describes the methods used to determine the potential risks to human and ecological receptors from chemicals detected in samples collected from the eight sites at the installation. A summary of the risks posed by chemicals detected at each of the sites is

presented on a site-by-site basis in Sections 3.0 and 4.0. The complete human health and ecological risk assessments are presented in the Oliktok Point Risk Assessment (U.S. Air Force 1996), which has been submitted under separate cover.

In addition to the methods for risk evaluation, this section presents contaminant fate and transport, general potential migration pathways, and receptor groups common to all of the Oliktok Point sites.

2.4.1 Human Health Risk

The evaluation of human health risk is conducted in accordance with standard risk assessment methodology as described in *Risk Assessment Guidance for Superfund (RAGS): Human Health Evaluation Manual, Part A* (EPA 1989b), *Region 10 Supplemental Risk Assessment Guidance for Superfund* (EPA 1991a), and the *Handbook to Support the Installation Restoration Program Statements of Work* (U.S. Air Force 1991). This section presents a summary of the approach used in evaluating the human health risks associated with the sites at the Oliktok Point radar installation.

The Oliktok Point DEW Line installation presented a unique challenge to the development of a human health risk assessment. Many of the conventional assumptions applied to risk assessments do not apply to the North Slope of Alaska. Oliktok Point is remote and sparsely populated. Native residents from surrounding areas, largely Inupiats, follow a lifestyle that includes a significant subsistence component; much of their food consists of mammals (whales, seals, and caribou), aquatic life (arctic char), and birds (ptarmigan and ducks) that are abundant in this area of the arctic. The climate is generally harsh, and the soil and surface water are frozen for approximately nine months of the year. The following paragraphs present some of the approaches and assumptions used in the development of the human health risk assessment.

The general approach to the human health risk assessment was to quantify the excess lifetime cancer risk and the noncancer hazard associated with exposure to the site contaminants detected at each of the eight sites at the installation. The maximum concentration of each chemical detected was used as the exposure point concentration instead of an arithmetic mean or 95th percentile upper confidence limit (UCL) because contamination was infrequently detected and found to be generally of low concentration. Incorporating nondetects into the calculation of an average or UCL when the frequency of positive detects is low tends to yield low and unreliable estimates of contamination. Use of the maximum concentration yields a more conservative estimate of risk or hazard.

Chemical concentrations detected in soil, sediment, or surface water samples from each of the sites were compared to risk-based screening levels (RBSLs), ARARS, and background concentrations. A chemical was selected as a COC if the maximum concentration at which the chemical was detected exceeded the corresponding background concentration, and the RBSL (based either on cancer risk or noncancer hazard) or an ARAR. In addition, chemicals detected above background levels were retained as potential COCs if no RBSL or ARAR was available. COCs selected in this manner were evaluated in the human health risk assessment.

An exposure pathway describes the course a chemical will take from a source to an exposure point where a receptor can come into contact with the chemical. The exposure pathways by which exposure to the COCs at Oliktok Point may occur include ingestion, dermal contact, and inhalation. The dermal contact and inhalation pathways were not considered complete or significant because the arctic climate precludes dermal contact with and volatilization of site contaminants, so they were not evaluated. Exposure pathways that were considered for all sites were incidental ingestion of soil/sediment and ingestion of surface water.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of a community on the North Slope of Alaska (native), and a child living in a North Slope community (child).

The risk assessment assumed a residential scenario when estimating the soil/sediment and water ingestion rates. The soil/sediment ingestion rate was based on EPA default values, 100 mg/day for adults and 200 mg/day for children. The drinking water ingestion rate assumed a potential future scenario in which the surface water where chemicals were detected at the site will be used as a source of drinking water for 180 days per year at the EPA default ingestion rate of 2 liters per day.

The exposure duration assumed a DEW Line worker would be stationed at the Oliktok Point installation for 10 years. The exposure duration for the native was estimated to be 55 years. EPA's default reasonable maximum exposure duration is 30 years; however, this is based on the residence time in one location for the continental United States. Because Alaskan natives are more likely to remain in North Slope communities for a longer period, 55 years was determined to be a more appropriate estimate of residence time.

The risk assessment was based on the assumptions just described, along with chemical-specific toxicity data, to quantitatively and qualitatively express the hazards and risks. To characterize potential noncancerous effects, comparisons were made between projected intakes of the COCs and chemical-specific toxicity values. The potential noncancerous health effects were expressed as a hazard quotient (HQ). To assess the overall potential for noncancerous effects posed by more than one chemical at a site, the HQs were summed and reported as the hazard index. An HQ or hazard index of 1.0 is the regulatory benchmark. Noncancer hazards greater than 1.0 are generally considered a concern, and noncancer hazards of less than 1.0 are generally considered to not warrant further evaluation (EPA 1991b).

To characterize the potential for carcinogenic effects, the probability that an individual will develop cancer over a lifetime of exposure, the risks were estimated from projected intakes of the COCs and chemical-specific dose-response information. The cancer risks are calculated on a chemical-specific basis and are added together (if more than one chemical associated with cancer risk is a COC at the site) to estimate the total cancer risk for the site. The total cancer risk for each pathway is generally not considered to be of concern unless it exceeds a value of 1×10^{-6} (EPA 1991b).

Excess lifetime cancer risk is the incremental increase over and above the background (i.e., if no exposure to site chemicals occurs) in the probability of developing cancer during one's lifetime.

For example, a 1 x 10^{-6} excess lifetime cancer risk means that, in a population of one million people exposed to the carcinogen throughout their lifetimes, the average incidence of cancer may increase by one case. The background probability among Americans of developing cancer at some time in their lives is about one in four (American Cancer Society 1993). The calculation of cancer risks uses information (i.e., cancer slope factors) developed by the EPA that represents upper bound estimates, so any cancer risks estimated in the risk assessment should be regarded as upper bounds on the potential cancer risks rather than accurate representations of true cancer risk. The true cancer risk is likely to be lower than that predicted (EPA 1989a).

Excess lifetime cancer risk and noncancer hazard were calculated for the soil/sediment ingestion and water ingestion pathways. Other pathways were eliminated from consideration as described in the Oliktok Point Risk Assessment (U.S. Air Force 1996). The risks and hazards associated with chemicals detected at the Oliktok Point sites are presented on a site-by-site basis in Sections 3.0 and 4.0 of this RI/FS report.

2.4.2 Ecological Risk

The objective of the environmental risk assessment (ERA) is to estimate potential impacts to aquatic and terrestrial plants and animals at the Oliktok Point DEW Line installation. The evaluation of environmental risks was conducted in accordance with current Air Force and EPA guidance, specifically, *Handbook to Support the Installation Restoration Program Statements of Work* (U.S. Air Force 1991), *Framework for Ecological Risk Assessment* (EPA 1992), and *Ecological Risk Assessment Guidance for Superfund* (EPA 1994).

The approach used to assess potential ecological impacts was conceptually similar to that used to assess human health risks. Potentially exposed populations (receptors) were identified, and information on exposure and toxicity was combined to derive estimates of risk. However, the scope of ERAs is generally different from that of human health risk assessments in that ecological assessment focuses on potential impacts to a population of organisms rather than to individual organisms (except in the case of endangered species where individuals are considered). In addition, because ecosystems are composed of a variety of species, ecological assessments evaluate potential impacts to numerous species instead of a single species (as is the case in human health assessments).

Ideally, ERAs should evaluate potential risks to communities and ecosystems, as well as to individual populations. However, because of the large number of species and communities present in natural systems, such ecosystem-wide assessments are very complex and appropriate assessment methodologies have not yet been developed. In addition, dose-response data on community or ecosystem responses are generally lacking. Therefore, evaluations of potential impacts to communities or ecosystems are qualitative.

The degree to which potential ecological impacts can be characterized is highly dependent upon the data available to support such estimates. Data required include: information regarding contaminant release, transport, and fate; characteristics of potential receptor populations; and adequate supporting toxicity data for the COCs. The degree to which the existing database can

meet these requirements dictates the extent to which potential ecological impacts can be evaluated.

Ecological receptors can be exposed to COCs through abiotic and biotic media. Potential exposure pathways for terrestrial and aquatic organisms include direct contact and ingestion of contaminated soil/sediment and/or surface water. The most significant route of exposure for plants is direct contact with soil. Aquatic organisms such as fish and invertebrates are primarily exposed through direct contact with surface water, but may be exposed to COCs through ingestion of plant and animal items in the diet, and incidental ingestion of soil/sediment while foraging (although only direct contact with surface water is used to develop risk estimates). Birds and mammals may be exposed to COCs through ingestion of surface water, ingestion of plant and animal diet items, and incidental ingestion of soil/sediment.

The potential ecological receptors evaluated in the risk assessment include plants, aquatic organisms, birds, and mammals likely to occur along the Arctic Coastal Plain. Representative species from these groups of receptors were selected based primarily on the species' likelihood of exposure given their preferred habitat and feeding habits. Species that may be particularly sensitive to environmental impacts, such as endangered or threatened species, were also evaluated. The representative and sensitive species are presented in Tables 2-6 and 2-7. Any threatened or endangered species evaluated in the ERA are not considered representative of the Arctic Coastal Plain or the DEW Line installations. These species are evaluated to provide information about whether they face potential risks from exposure to COCs.

Potential risks to representative species were estimated by evaluating sampling data for the relevant exposure media (i.e., soil/sediment and surface water). Potential risks to plants were evaluated based on a comparison of the average contaminant concentrations in the site soil/sediment via toxicity information in the literature. Potential impacts on aquatic receptors were evaluated by comparing average surface water concentrations to toxicity reference values (TRVs). Potential impacts to birds and mammals were evaluated for selected representative species by comparisons of estimated exposures, based on potential dietary intakes of COCs, to TRVs. TRVs for representative species are derived by selecting toxicity values from the literature and extrapolating to the species of concern. TRVs are then divided into the estimated exposure concentration to derive the HQ. If the HQ is less than one, then adverse effects are not expected. Conversely, if the HQ is equal to or greater than one a potential for adverse effects exists. The confidence level of the risk estimate is increased as the magnitude of the HQ departs from 1.0. For example, there is greater confidence in a risk estimate where the HQ is 0.1 or 10, than in an HQ such as 0.9 to 1.1.

TRVs are calculated to be protective for long-term exposures. This is accomplished by using chronic chemical and receptor-specific no-effect dosages as starting points when such data is available. If chronic or receptor-specific data is not available, then uncertainty and scaling factors (to account for differences in body size) are incorporated in the derivation of the TRVs. This is standard practice in ERAs and is illustrated in screening level benchmarks used in the ERA for sediments (Hull and Suter 1994), aquatic biota (Suter and Mabrey 1994), and wildlife (Opresko et al. 1994). The assumptions incorporated in the ERA assume daily exposure during the receptor's most sensitive life stage (i.e., one breeding season). Consequently, if no risks are

TABLE 2-6. REPRESENTATIVE SPECIES AT THE DEW LINE INSTALLATION SITES

COMMON NAME	GENUS AND SPECIES
Sedge	*Carex* spp.
Cottongrass	*Eriophorum* spp.
Willow	*Salix* spp.
Berries	*Vaccinium* spp.
Water fleas	*Daphnia* spp.
Nine-spined stickleback	*Pungitius pungitius*
Arctic char	*Salvelinus alpinus*
Lapland longspur	*Calcarius lapponicus*
Brant	*Branta bernicla*
Glaucous gull	*Larus hyperboreus*
Pectoral sandpiper	*Calidris melanotos*
Brown lemming	*Lemmus trimucronatus*
Arctic fox	*Alopex lagopus*
Barren-ground caribou	*Rangifer tarandus*

TABLE 2-7. THREATENED AND ENDANGERED SPECIES CONSIDERED IN THE ECOLOGICAL RISK ASSESSMENT

COMMON NAME	GENUS AND SPECIES
Spectacled eider[a]	*Somateria fischeri*
Steller's eider[b]	*Polysticta stelleri*

a threatened status
b candidate for threatened status

identified at the "chronic" level, there will be no risk related to "acute", or occasional exposures. This should be kept in mind when interpreting the HQ. Although the HQ may be greater than one, the conservatism embodied in the TRV and assumptions of the ERA allow for mitigating factors (e.g., large home range, short seasonal exposure, unlikely repeated exposures at a "hot spot" location) that may result in a finding of no significant risk.

The ERA was intended to be at a screening level, rather than a full scale investigation of the state of the ecosystem. No specific onsite studies of the biota were undertaken. The assessment was based on media sampling (i.e., surface water and soil/sediment samples). The ecological risks associated with the chemicals detected at the Oliktok Point sites are presented site-by-site in Sections 3.0 and 4.0 of this RI/FS report. The complete ERA is presented in the Section 3.0 of the Final Oliktok Point Risk Assessment (U.S. Air Force 1996).

2.4.3 Contaminant Fate and Transport

The fate and transport of the COCs in soil/sediment, active layer water, and surface water have been accounted for in the sampling plan. Known source areas were sampled, and the extent of migration was evaluated by sampling at increasing distances from the source area. Surface and subsurface sampling was conducted in gravel pads and tundra areas to characterize the extent of contaminant migration. Water samples were collected in streams and ponds and analyzed to evaluate the migration of contamination from source areas to water bodies potentially used by human or ecological receptors. The potential for contaminant migration is discussed on a site-specific basis in Sections 3.0 and 4.0.

2.4.4 General Migration Pathways

This section presents general information concerning migration pathways for the sites at the Oliktok Point radar installation. Site-specific migration pathways are discussed in Sections 3.0 and 4.0.

The potential for contaminant migration exists for any site where a release has occurred. The threat that a contaminated site presents to human health or the environment was assessed according to the potential for contaminant migration, human or ecological receptors, and contaminant concentrations to which the receptors may be exposed.

There are three main pathways through which contaminants may reach human and ecological receptors. These pathways are subsurface migration (in affected active layer water), surface migration, and air transportation (as vapors or dust). Potential migration pathways are depicted in Figure 2-3. Figures 2-4 and 2-5 present the potential exposure pathways for the human and ecological receptors, respectively. The discussion of migration pathways is preceded by a general description of the topography and stratigraphy at Oliktok Point.

2.4.4.1 Topography. The Oliktok Point installation is located along the coast of the Beaufort Sea. The main structures at the installation are located approximately one-eighth mile south of the coastline. Drainage at the installation is poorly developed and consists of small drainage features that connect larger puddles, tundra ponds, and marshy areas. Drainage in the

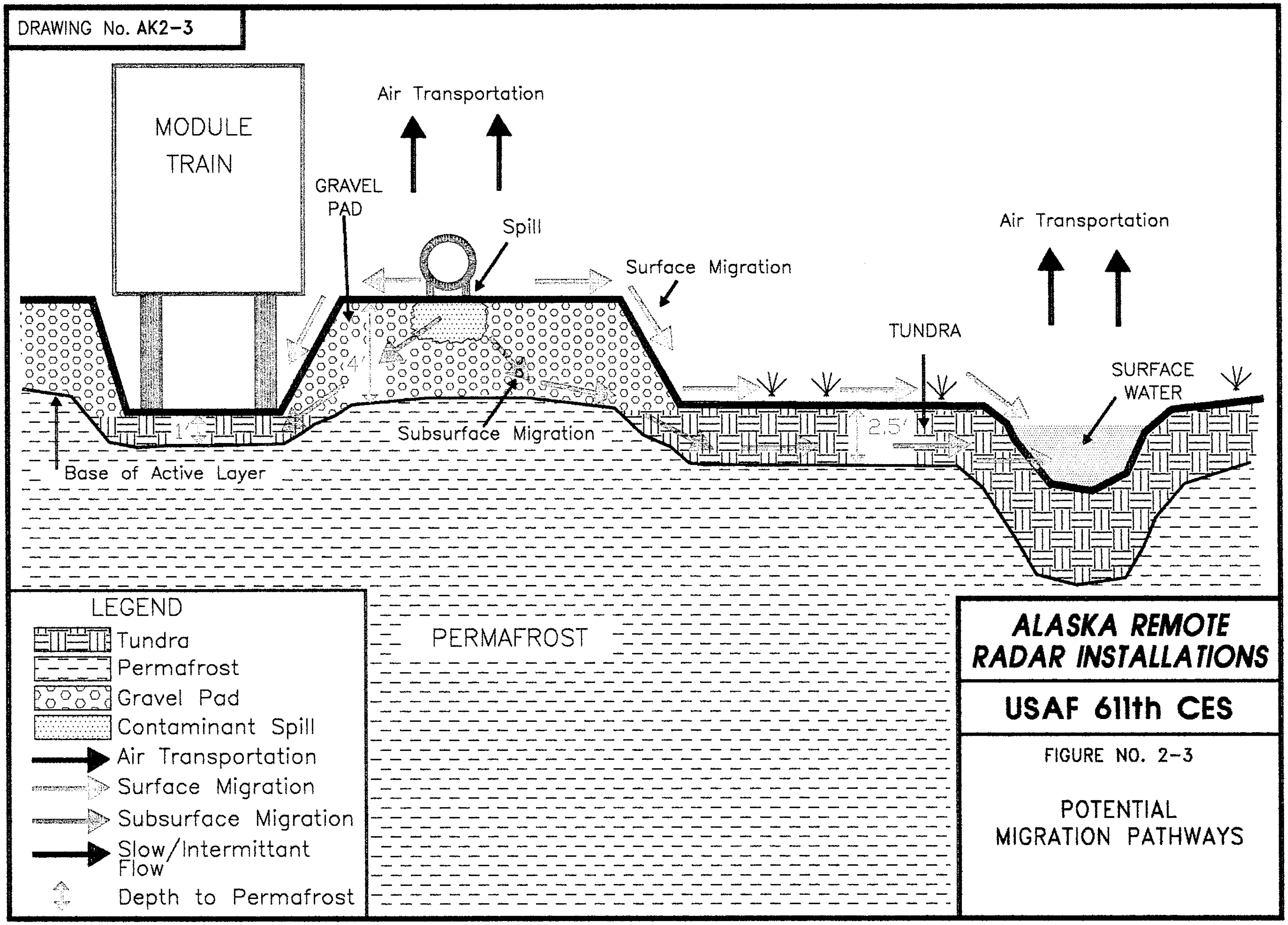
DRAWING No. AK2-3
MODULE TRAIN
Air Transportation
GRAVEL PAD
Spill
Surface Migration
Air Transportation
TUNDRA
SURFACE WATER
4'
1'
2.5'
Subsurface Migration
Base of Active Layer
PERMAFROST
LEGEND
Tundra
Permafrost
Gravel Pad
Contaminant Spill
Air Transportation
Surface Migration
Subsurface Migration
Slow/Intermittant Flow
Depth to Permafrost
ALASKA REMOTE RADAR INSTALLATIONS
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FIGURE NO. 2-3
POTENTIAL MIGRATION PATHWAYS

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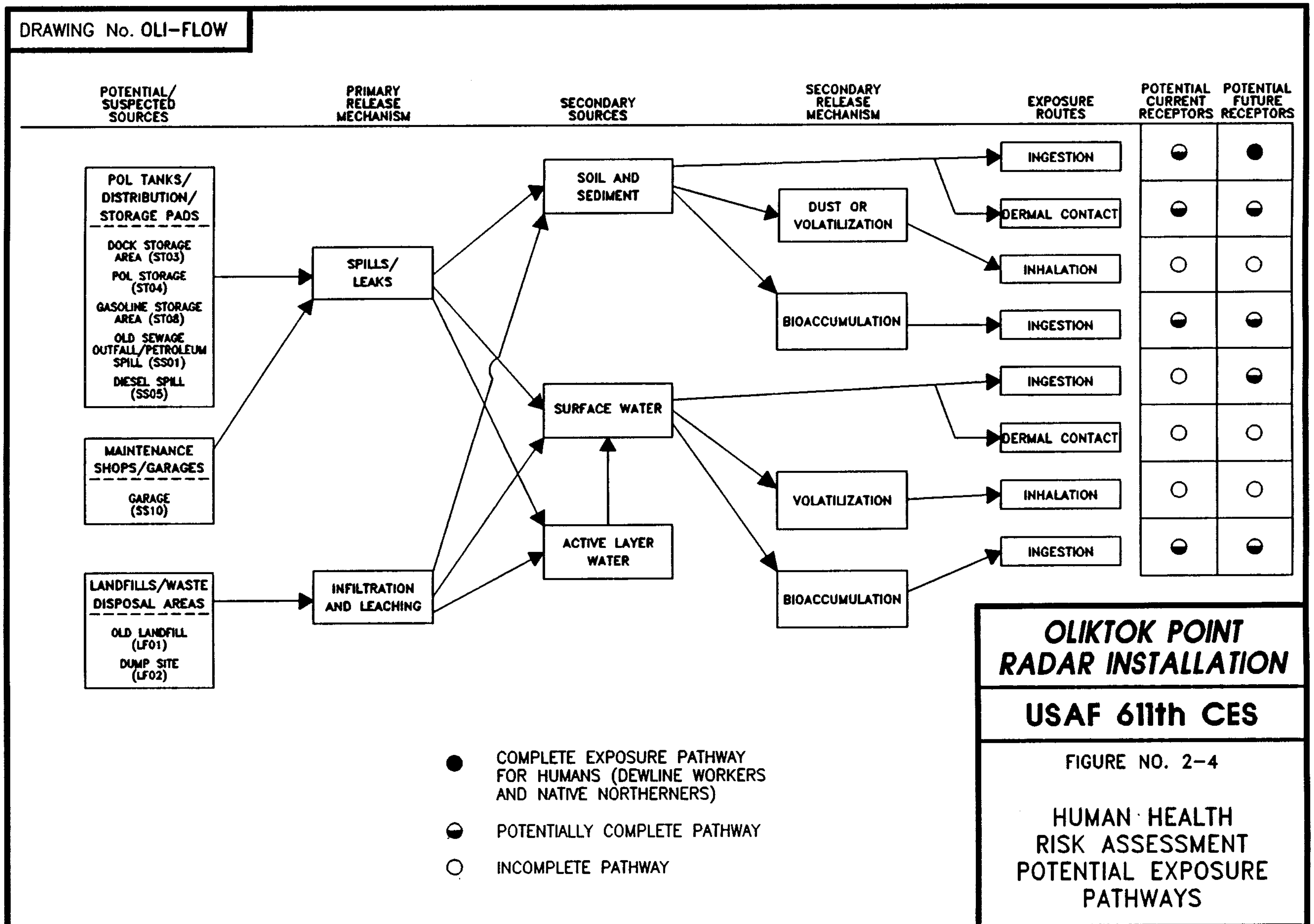

FIGURE NO. 2-4

HUMAN HEALTH RISK ASSESSMENT POTENTIAL EXPOSURE PATHWAYS

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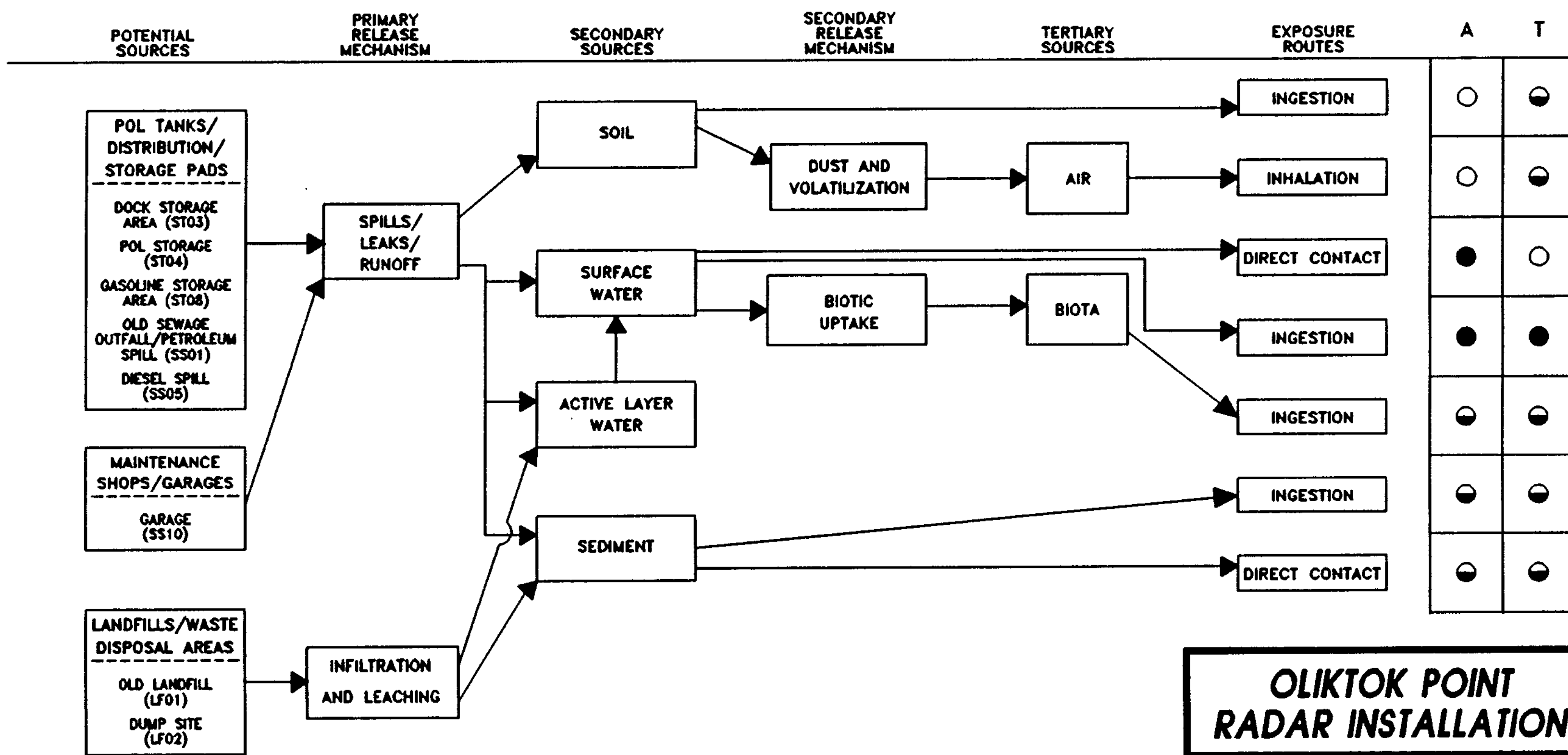

A AQUATIC RECEPTORS

T TERRESTRIAL RECEPTORS

● COMPLETE EXPOSURE PATHWAY

◒ POTENTIALLY COMPLETE PATHWAY

○ INCOMPLETE OR INSIGNIFICANT EXPOSURE PATHWAY

OLIKTOK POINT RADAR INSTALLATION

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FIGURE NO. 2-5

ECOLOGICAL RISK ASSESSMENT POTENTIAL EXPOSURE PATHWAYS

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area of the main installation generally is toward the Beaufort Sea. Drainage in other areas of the installation generally are radial from the raised gravel pads to the surrounding relatively flat tundra areas.

Little topographic relief is expressed at the Oliktok Point installation; the maximum elevation is approximately 25 feet above MSL. The tundra surface is flat or very slightly sloping. Gravel pads, roads, and airstrip, which are of human origin, rise approximately four to five feet above the tundra. The edges of these features are sloped at the angle of repose for unconsolidated sands and gravels.

South, east, and west of the main station facilities, the most prominent natural topographic features, visible from the air and ground surface, are ice wedge polygons. These features are formed by cracking of the ground surface during thermal contraction, followed by infiltration of water. The water then freezes and forces the crack wider. Repeated freeze-thaw cycles enlarge these features, which form small troughs and may fill with water. Intersecting troughs form polygonal arrangements that range from a couple of feet to tens of feet across.

Two types of ice wedge polygons exist: low centered and high centered. In low centered polygons, the middle of the polygon is depressed to form a small basin, which may fill with water. A cross-section of one of these basins would reveal an ice-wedge trough on either side of the polygon, berms lining both sides of the troughs, and a basin filling the interior space between the berms. A high centered polygon does not have a depressed center, and consists of intersecting troughs with higher ground in the middle.

Oriented lakes are another prominent tundra feature. These lakes, which form from low centered polygons, are enlarged by the erosional action of wind-induced waves. These lakes are generally not circular but oblong, with the long axis of the lake normal to the prevailing wind direction. They can "migrate" across the tundra at an average rate of three feet per year (Livingstone 1954) and have a stable depth of approximately 10 feet (Hussey and Michaelson 1966).

2.4.4.2 Stratigraphy. The stratigraphy at Oliktok Point was examined during RI activities down to the level of the permafrost (generally no deeper than two to four feet during August and September 1993). The upper-most features at the site are gravel roads and pads of human origin. These features, which are limited in areal extent, have a maximum height of approximately six feet. They generally consist of well-graded sandy gravels with sub-angular to sub-rounded, very fine to coarse sands and sub-angular to sub-rounded gravel clasts ranging from one-quarter inch to one and one-half inches (although gravel clasts ranging up to four inches or more are occasionally encountered). The grains are unconsolidated, and fine material (silts or clays) may be present in minor quantities.

Gravel pads and roads were constructed on top of native tundra, which occurs throughout the site. The top of the tundra consists of a vegetative mat in a loamy/silty matrix. This mat can reach several inches in thickness. Underlying the tundra mat are fine to coarse sands and gravels, dark brown organic clays, and silt layers. The depth to permafrost beneath the tundra was approximately two feet during the 1993 RI. Adjacent to the Beaufort Sea, beaches are present that consist of poor to well sorted sub-rounded to rounded, fine to coarse sands, and

sub-rounded to rounded gravel clasts of varying size; minor amounts of fine material are also present.

2.4.4.3 Subsurface Migration. Active layer water flow under the tundra is hampered by the presence of numerous wet depressions and the relatively flat topography; because the depth to permafrost under these depressions is increased, they tend to act as small catchment basins. These basins limit the potential for the horizontal flow of active layer water (Miller et al. 1980; Robertson 1988). The active layer water flow in these areas is so inhibited that it can contribute little to the midsummer water budget of tundra streams. Most of the active layer water contribution to these streams is from immediately adjacent well-drained slopes (Robertson 1988).

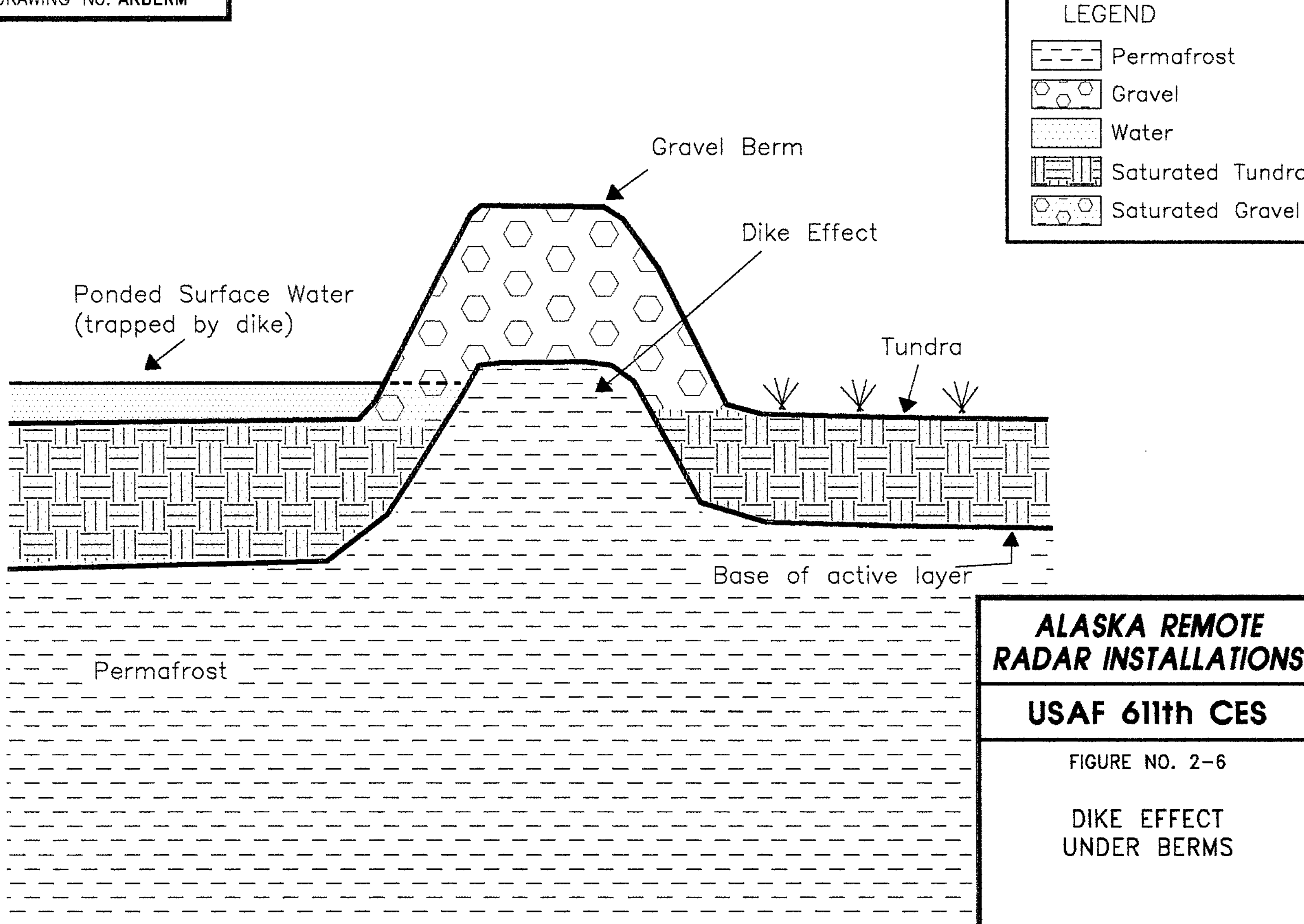
Some generalizations about active layer water flow can be made. Due to the combined effects of low topographic relief and the presence of numerous catchment basins, active layer water migration through areas of tundra is a slow process. The active layer water contribution to tundra streams is mainly from well-drained slopes next to those streams. The active layer water flow that does occur is governed by changes in topographic relief and is limited to spring and summer months, with the active layer functioning as a shallow, unconfined aquifer. The water table in such an aquifer tends to mimic topographic features, and active layer water flow is driven by elevation changes. Figure 2-6 illustrates how the elevation changes of gravel roads and berms can restrict active layer water flow.

2.4.4.4 Surface Migration. Surface migration at the Oliktok Point installation may occur as a result of the flow of surface water from topographic highs to topographic lows. Surface water flow during the spring thaw, when mounds of snow can channel drainage in unexpected directions, can be markedly different from flow during the summer months. The general surface migration features and directions are depicted in Figure 1-8.

The main factors controlling surface water flow are the topography and water availability. The topography at the Oliktok Point installation has very little relief; therefore, there is only a small gradient to drive surface water flow. Combined with the depressions formed by the ice wedge polygons and gravel roads and berms, this creates a multibasinal drainage pattern in which much of the surface water is directed into depressions and small tundra ponds, rather than directly into drainage channels. Gravel pads provide the greatest topographic relief at the installation. Surface migration is generally radial out from the gravel pads.

Based upon precipitation alone, Oliktok Point could classify as a desert (Robertson 1988). Precipitation along the Beaufort Sea coast averages only seven inches per year (Dingman et al. 1980; Walker et al. 1980). Additionally, 65 percent of the precipitation on the North Slope is in the form of snow (Walker et al. 1980). Most surface water flow occurs during the spring, when melting snow and ice release stored water over a relatively short time-frame and the active layer remains partially frozen. This creates a situation in which there is a large supply of surface water and very little capacity for infiltration. The result is the overland sheet flow (Robertson 1988), during which drainage is not confined to local drainage features but may travel in a sheet-like fashion over the topography. Snow, ice, and man-made features (gravel pads and roads) may also result in barriers that force the flow of surface water in directions different from those dictated by the underlying ground surface.

DRAWING No. AKBERM



ALASKA REMOTE RADAR INSTALLATIONS

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FIGURE NO. 2-6

DIKE EFFECT UNDER BERMS

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There is comparatively little flow of surface water during the summer. In fact, arctic wetlands exist because the lack of significant vertical relief retards the horizontal flow of surface water, and permafrost limits downward flow (Robertson 1988). Overflow from tundra ponds is generally dependant upon summer rainfall.

The potential for contaminant migration in surface water is, therefore, greatest during the spring thaw, which is of relatively short duration, during which the precise direction of flow may be difficult to determine. There are no distinct streams or rivers at the Oliktok Point installation.

2.4.4.5 Air Transport. Air transportation of contaminants is not considered to be a significant migration pathway at Oliktok Point. The frozen conditions encountered most of the year are not conducive to the volatilization of organic contaminants or to the transport of affected dust and dirt. During the summer months, the air and ground temperatures remain relatively low (reducing volatility), and the abundant supply of moisture retards the entrainment of affected dust.

2.4.5 Receptors

Three potential human receptor groups were evaluated for the Oliktok Point Risk Assessment: an adult assigned to a DEW Line installation (worker), an adult native of the North Slope of Alaska (native), and a native child (child). These receptor groups represent the reasonable maximum exposure at an installation that potentially could be released for civilian use at some time in the future.

The primary routes of human exposure evaluated in the Oliktok Point Risk Assessment are incidental ingestion of soil/sediment and ingestion of surface water.

For the ecological evaluation it was assumed that terrestrial and aquatic species are potential receptors for at least the six months of the year when the region is not ice and snow covered. In addition, it was assumed that species that occur at great distances from the specific installations are not receptors (e.g., whales). Whales may migrate off-shore from the DEW Line installation; it is unlikely, however, that these mammals are potential receptors to COCs released from the sites because of dilution of surface water entering the Arctic Ocean and the distance off-shore that these animals migrate. Potential ecological receptors evaluated in the ERA were discussed in Section 2.4.2.

The potential human health and ecological risks to receptors associated with the contaminants detected at the Oliktok Point sites are reported on a site-specific basis in Sections 3.0 and 4.0.

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3.0 REMEDIAL INVESTIGATION - NO FURTHER ACTION SITES

This section of the RI/FS presents results from RI sampling and analysis activities for each of the four Oliktok Point sites recommended for no further action. The four sites considered for no further action and discussed in this section are the Old Landfill (LF01), Dump Site (LF02), Dock Storage Area (ST03), and POL Storage (ST04). Each of the no further action sites is presented individually in Sections 3.1 through 3.4. (Note: figures and tables are presented at the end of each section.) The information presented for each site includes site background, field sampling and analytical results, potential migration pathways, human health and ecological risk assessment summaries, and conclusions and recommendations. The site-by-site discussions in this section are intended to provide the reader with all information needed to support no further action at each of the sites.

Photographs of the Oliktok Point installation and the sites investigated during the RI are presented in Appendix B. Data tables in this section list analytical results from samples in which chemicals were detected above quantitation limits. Complete laboratory analytical data sheets for each sample, including quantitation limits for non-detected analytes, are presented in Appendix F.

3.1 OLD LANDFILL (LF01)

3.1.1 Site Background

The Old Landfill is the location of the old installation landfill that received all wastes generated by the station, other than those that were incinerated, from 1956 to approximately 1978. The site was cleaned, covered, and reseeded between 1978 and 1980. It is located approximately one quarter mile west of the main installation. The site is less than one acre in size and is bordered on the west by a lagoon, to the south by tundra, and to the north by beach sand and gravels.

Previous sampling, conducted in 1986 and 1987 by Air Force contractors, detected one VOC and one metal in surface water at the site. A detailed list of concentrations of chemicals detected previously is presented in the RI/FS Work Plan (U.S. Air Force 1993a).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.1.3.

3.1.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Old Landfill (LF01). The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.1.2.1 Summary of Samples Collected. Nine samples were collected from gravel areas, beach sands, and drainage pathways at the site. These consisted of four soil, two sediment, and

three surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Old Landfill (LF01) are presented in Figure 3-1.

All of the soil and sediment samples were analyzed for DRPH, GRPH, residual range petroleum hydrocarbons (RRPH), BTEX, HVOCs, and PCBs. In addition, one soil and one sediment sample were analyzed for VOCs, SVOCs, and total metals.

Three surface water samples were analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, and PCBs. In addition, one sample was analyzed for VOCs, SVOCs, total and dissolved metals, TSS, TDS, and TOC.

3.1.2.2 Analytical Results. The data summary table (Table 3-1) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-1. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. Only metals detected above background levels that exceed an RBSL or ARAR are presented on Figure 3-1. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil/sediment samples collected at the site include GRPH, BTEX, HVOCs, and PCBs. GRPH and BTEX (total BTEX) were detected in soil sample LF01-S03-1.5 at 5 and 0.26 mg/kg, respectively. Two HVOCs (tetrachloroethene and trichloroethane) were detected at very low concentrations (0.04 and 0.4 mg/kg, respectively) in the same soil sample. PCBs (Aroclor 1254) were detected in two soil samples, LF01-S01 and LF01-S03-1.5, at 0.8 and 8.1 mg/kg, respectively.

In surface water samples, organic compounds detected include GRPH and BTEX. GRPH were detected in surface water sample LF01-SW03 at 70 µg/L. Toluene, ethylbenzene, and xylenes were detected at 24, 3, and 31 µg/L, respectively, in the same surface water sample.

Inorganics. Metals analyses indicated that two metals (lead and sodium) were detected above background concentrations in soil sample LF01-S01. Lead and sodium were detected at 69 and 1,000 mg/kg, respectively.

In surface water sample LF01-SW01, metals analyses detected four metals at levels above background concentrations. Barium, magnesium, potassium, and sodium were detected at 170; 59,000; 13,000; and 490,000 µg/L, respectively. TOC, TSS, and TDS were reported at 18,100; 35,000; and 3,912,000 µg/L, respectively, in surface water sample LF01-SW01.

3.1.2.3 Summary of Site Contamination. Previous sampling conducted in 1986 and 1987 at the Old Landfill (LF01) site detected trichlorofluoromethane (a highly volatile halocarbon) in a surface water samples at 0.67 and 1.2 μg/L, and lead in one of the surface water samples at 0.03 μg/L. The results and sources of previous sampling efforts are presented in the RI/FS Work Plan (U.S. Air Force 1993a). The quality of the previous IRP sampling data is unknown as is the data validation, if any, that these data have undergone.

Sampling and analyses have determined that low levels of GRPH and VOCs (including BTEX) exist in soil and surface water, and very low levels of PCBs exist in soil at the site. Metals detected in surface water at the site were not detected at a level of concern. Lead was selected as a COC for soil and was evaluated in the ecological risk assessments and was determined not to pose significant risk.

A comparison of historical and current project data indicates that there is a lower concentration of trichlorofluoromethene than there has been in the past; however, very low levels of other organic compounds were detected during the 1993 RI. Differences between past and current data are likely to be the result of more extensive sampling during the 1993 RI. A comparison of previously detected metals to current site background metal concentrations indicates that the lead previously detected was not detected at a level of concern.

The primary contaminants at the site are very low concentrations of petroleum hydrocarbons (GRPH and BTEX) and Aroclor 1254. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 3.1.4 and 3.1.5. The suspected source of petroleum compounds detected during sampling conducted at the Old Landfill is buried garbage and debris from previous waste disposal practices. The landfill has been inactive since 1978.

3.1.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.1.3.1 Topography and Stratigraphy. The site is relatively flat. It consists of a gravel pad placed upon both tundra to the south and beach sands and gravels to the north. The gravel pad has been graded to approximately the same elevation as the surrounding areas. An estuary is located adjacent to the northwest portion of the site.

The active layer at this site was approximately two feet thick in tundra areas and four feet thick under gravel pads and roads during the 1993 RI. Gravel pad material consisted of the typical gravels and sands associated with these features, and subsurface tundra materials were of the typical stratigraphy found at Oliktok Point (Section 2.4.4.2). Along the beach, subsurface materials consisted of the typical sands, gravels, and fine materials associated with these features.

3.1.3.2 Migration Potential.

Subsurface Migration. Topography at the site indicates that subsurface water flow should be to the north and west towards the Beaufort Sea and the adjacent estuary, and the flow should be velocities should be relatively low. There are several seasonal seeps along the west side of the site that drain into the adjacent estuary. Analytical data collected from one of these seeps indicate that there is a potential for subsurface migration of contaminants from the site.

Surface Migration. Surface migration at the site is to the west and north towards the estuary and the Beaufort Sea. The primary route of surface migration over most of the site is overland sheet flow. Significant surface migration over the gravel pad area is probably restricted to the spring thaw when large quantities of meltwater are available and the frozen ground prevents active layer flow. Surface migration on the gravel pad will follow surface contours, which are generally radial from the gravel pad out to the tundra and surface water bodies that border the site. The flat topography of the tundra indicates that surface migration of contaminants should be minimal.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Analytical data suggest that there is a potential for limited subsurface migration of low levels of contaminants. The flat topography in the area indicates that any subsurface or surface migration should occur very slowly. Based upon the analytical results and site topography, the potential for contaminant migration from this site is considered to be low.

3.1.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Old Landfill (LF01) site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with, and incidental ingestion of, soil/sediment and ingestion of surface water. Because ground water and air at the Oliktok Point sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Oliktok Point Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The risk estimates for native adults and children were based on a potential future residential scenario (i.e., the installation is released for civilian use). The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Oliktok Point are presented in Section 3.1.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Oliktok Point Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be affected by the chemicals detected at the Oliktok Point installation. Because of the diversity of the plants and animals in the area of the Oliktok Point installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Tables 2-6 and 2-7.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Oliktok Point. The potential ecological risks associated with the chemicals at detected at the site are presented in Section 3.1.5.

3.1.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Old Landfill (LF01). The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway evaluated, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to RBSLs and ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.1.4.1 Chemicals of Concern. PCBs (Aroclor 1254) were identified as a COC for the soil matrix at the Old Landfill. The maximum concentration of Aroclor 1254 exceeded the background concentration and the RBSL based on noncancer hazard.

GRPH were identified as a COC for surface water at the Old Landfill because concentrations exceeded background levels and the RBSL based on cancer risk.

Table 3-2, Identification of COCs at the Old Landfill, presents the maximum concentrations of chemicals detected at the site, the associated background concentrations, RBSLs, and ARARs, and the COCs selected in the risk evaluation.

3.1.4.2 Exposure Pathways and Potential Receptors. Because COCs were identified in soil/sediment and surface water at the site, the potential risks associated with ingestion of soil/sediment and surface water were evaluated in the human health risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

3.1.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Old Landfill by a hypothetical native northern adult/child is 0.08, and by a DEW Line worker is 0.004, based on the maximum concentration of the COC. The presence of Aroclor 1254 accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the Old Landfill by a hypothetical native northern adult/child is 1×10^{-5}, and by a DEW Line worker is 5×10^{-7}, based on the maximum concentration of the COC. The presence of Aroclor 1254 accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the Old Landfill by a hypothetical native northern adult or a DEW Line worker is 0.005, based on the maximum concentration of the COC. The presence of GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the Old Landfill by native a northern adult is 1×10^{-6}, and by a DEW Line worker is 2×10^{-7}, based on the maximum concentration of the COC. The presence of GRPH accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

3.1.4.4 Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Old Landfill are limited to the very low noncancer hazards (hazard indices of 0.08 and 0.004) and the low cancer risks associated with Aroclor 1254. These risks and hazards were calculated conservatively based on ingestion of soil at a rate associated with a potential future residential scenario. It is very unlikely that the soil at this location would be ingested at the conservative rate used in the risk calculation, and the hazards and risks at the site are likely to be overestimated. In addition, remedial action is generally not warranted at sites where the excess lifetime cancer risk is less than 1×10^{-4} and the noncancer hazards do not exceed one (EPA 1991b).

The potential risks and hazards associated with the surface water at the Old Landfill are the very low noncancer hazard (hazard index of 0.005), and low cancer risk associated with the GRPH. Remedial action is generally not warranted at sites where the excess lifetime cancer risk is less than 1×10^{-6} and the noncancer hazards do not exceed one (EPA 1991b), and on the basis of the risk assessment remediation of the site is not warranted. In addition, the potential risks and hazards were calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the chemicals in surface water do not currently pose a health hazard nor are they likely to pose a hazard in the future.

The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not known to be used as a water supply now, nor has it been used in the past.

In conclusion, under current uses the COCs identified soil/sediment and surface water at the Old Landfill pose only minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.1.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the Oliktok Point installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.1.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation wide concentrations of COCs were used to calculate the risk estimates. All sites at the installation were considered to be potentially usable habitat. It should be noted that the COC selection process only considered the soil/sediment samples that were at or less than 1.5 feet deep. The soil/sediment samples were screened for depth because it is unlikely that any of the representative species will be exposed to soils/sediments deeper than 1.5 feet. No COC was identified in surface water. The COCs in soils at the Old Landfill were toluene, ethylbenzene, xylenes, PCBs, and lead. None of the identified COCs were associated with significant ecological risk estimates at the Old Landfill.

3.1.5.2 Summary of Ecological Risk Assessment. Based on the quantification of potential risks to ecological receptors and discussions presented in the Oliktok Point ERA, ecological risks at the Old Landfill are not significant.

3.1.6 Conclusions and Recommendations

Sampling and analyses have determined that there is no significant contamination at the Old Landfill (LF01). Only relatively low levels of contaminants were detected. Their source is suspected to be previous waste disposal at the Old Landfill, which is no longer active.

There does not appear to be any significant migration of contaminants from the site based on the surface water and sediment samples collected in drainage pathways leading from the site.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. Even using the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action. Based on the RI sampling and analyses, risk assessment, and current or future site uses, remedial actions are not warranted at the site. No significant human health or ecological risks were identified at the site. Therefore, the Old Landfill is recommended for no further action.

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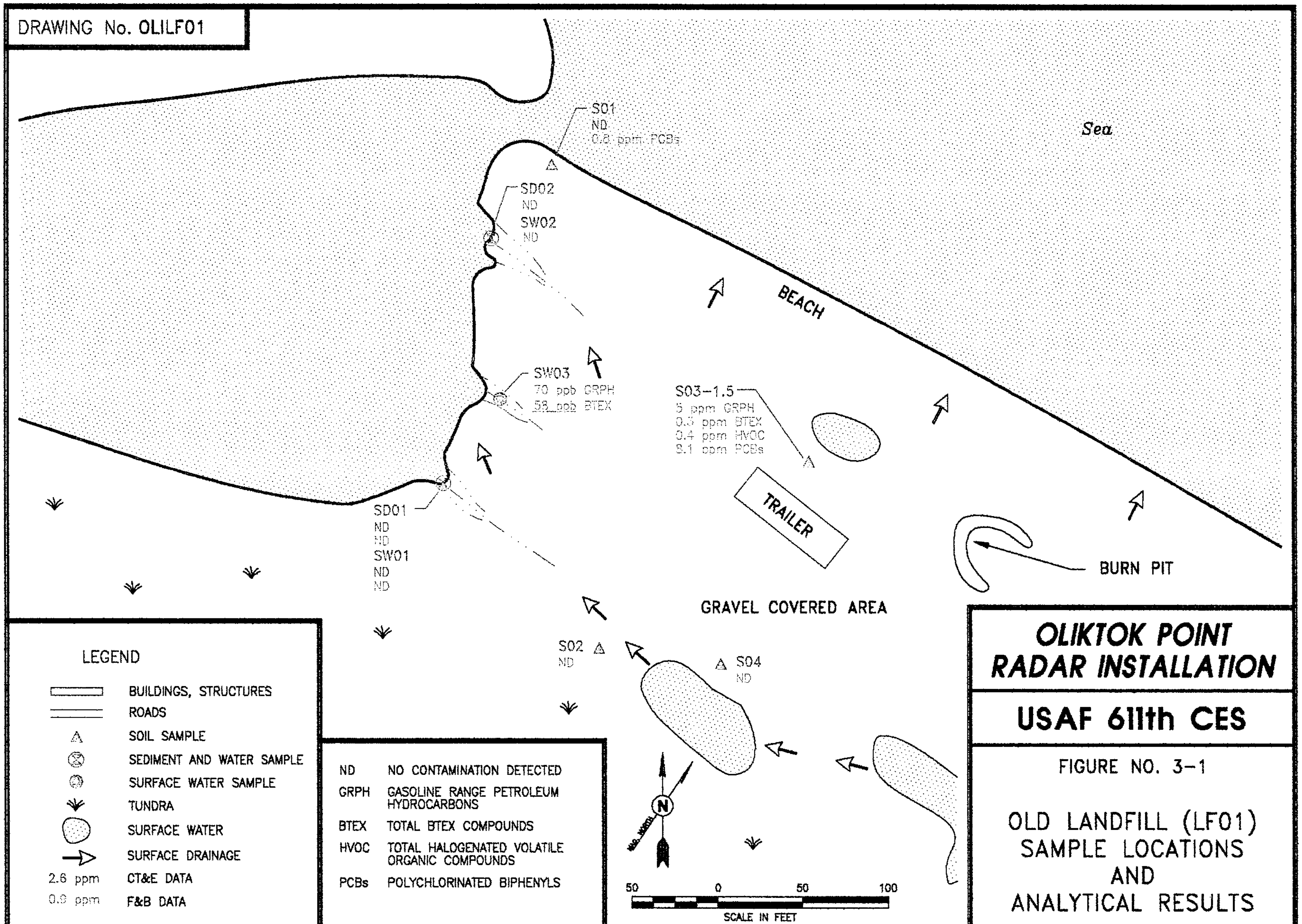

DRAWING No. OLILF01
Sea
S01
ND
0.8 ppm PCBs
SD02
ND
SW02
ND
BEACH
SW03
70 ppb GRPH
58 ppb BTEX
S03-1.5
5 ppm GRPH
0.3 ppm BTEX
0.4 ppm HVOC
8.1 ppm PCBs
TRAILER
BURN PIT
SD01
ND
ND
SW01
ND
ND
GRAVEL COVERED AREA
S02
ND
S04
ND
N
50 0 50 100
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
SEDIMENT AND WATER SAMPLE
SURFACE WATER SAMPLE
TUNDRA
SURFACE WATER
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
ND NO CONTAMINATION DETECTED
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
HVOC TOTAL HALOGENATED VOLATILE ORGANIC COMPOUNDS
PCBs POLYCHLORINATED BIPHENYLS
OLIKTOK POINT RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 3-1
OLD LANDFILL (LF01) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-1 OLD LANDFILL ANALYTICAL DATA SUMMARY

Installation: Oliktok Point
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					S01	S02	S03-1.5	S04	SD01	SD02	AB01	EB03	TB03		
Laboratory Sample ID Numbers					164/165 4267-4	166/167	168/169	170/171	160/161 4267-1	162/163	4209-7 4214-6	192/195 4268-2	190 4268-1	#1&2-82093 #5-82093 4209/4214 4268	#5-81993 #5-82093 #1&2-82093 4267
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	13.8J[d]-167J[d]	<50[b]	<50[b]	<50[b]	<50[b]	<50[b]	<50[b]	NA	<1,000[b]	NA	NA	<50
GRPH	0.1	1	100	<0.600-<1.00	<1J[b]	<1J[b]	5J[b]	<1J[b]	<1J[b]	<1J[b]	NA	<50J[b]	<50J[b]	<50	<1
RRPH (Approx.)	10	100	2000[a]	NA	<100	<100	<100	<100	<100	<100	NA	<1000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.10J	<0.10	0.26J	<0.10	<0.10	<0.10					
Benzene	0.002	0.02	0.5	<0.030-<0.060	<0.02J	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.030-<0.060	<0.02J	<0.02	0.1	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.030-<0.060	<0.02J	<0.02	0.1	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.060-<0.120	<0.04J	<0.04	0.06J	<0.04	<0.04	<0.04	<2	<2	<2	<2	<0.04
HVOC 8010															
Tetrachloroethene	0.002	0.02		NA	<0.02J	<0.02	0.04	<0.02	<0.02	<0.02	NA	<1	<1	<1	<0.02
Trichloroethane	0.002	0.02		NA	<0.02J	<0.02	0.4J	<0.02	<0.02	<0.02	NA	<1	<1	<1	<0.02
VOC 8260	0.020	0.025		<0.030-<0.045	<0.025	NA	NA	NA	<0.025	NA	<1	<1-3.3	<1	<1	<0.020
SVOC 8270	0.20	0.230-0.949		<0.330-<3.30	<0.230-0.949U	NA	NA	NA	<0.230-<1.00	NA	NA	<22	NA	<10	<0.010
PCBs															
Aroclor 1254	0.01	0.1	10	<0.030-<0.100	0.8J	<0.1	8.1J	<0.1	<0.1	<0.1	NA	<2	NA	NA	<0.01

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank	Lab Blanks
					S01	SD01				EB03	
Laboratory Sample ID Numbers					4267-4	4267-1				4268-2	4267 4268
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	1,600J	2,100				<100	<100
Antimony	N/A	53-57		<7.8-<230	<53J	<57				<100	<100
Arsenic	0.11	5.3-5.7		<4.9-8.5	<5.3	<5.7				<100	<100
Barium	0.024	1		27-390	100	130				<50	<50
Beryllium	N/A	2.7-2.9		<2.6-6.4	<2.7	<2.9				<50	<50
Cadmium	0.33	2.7-2.9		<3.0-<3.6	<2.7	<2.9				<50	<50
Calcium	0.69	4		360-59,000	4,800J	4,200				<200	<200-378
Chromium	0.066	1		<4.3-47	4.1J	16				<50	<50
Cobalt	N/A	5.3-5.7		<5.1-12	<5.3	<5.7				<100	<100
Copper	0.045	1-19		<2.7-45	<19	8.6				<50	<50
Iron	0.50	2		5,400-35,000	5,800	7,600				<100	<100
Lead	0.13	2-5.7		<5.1-22	69	<5.7				<100	<100
Magnesium	0.96	4		360-7,400	1,100	1,100				<200	<200
Manganese	0.25	1		25-290	73	160				<50	<50
Molybdenum	N/A	2.7-2.9		<2.5-<11	<2.7	<2.9				<50	<50
Nickel	0.11	1		4.2-46	6.5	14				<50	<50

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank	Lab Blanks
					S01	SD01				EB03	
Laboratory Sample ID Numbers					4267-4	4267-1				4268-2	4267 4268
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L
Potassium	23	100		<300-2,200	340	320				<5,000	<5,000
Selenium	1.2	5.3-5.7		<7.8-<170	<5.3	<5.7				<100	<100
Silver	0.53	2.7-2.9		<3-<110	<2.7	<2.9				<50	<50
Sodium	0.55	5		<160-680	1,000	370				290	<250
Thallium	0.011	0.28-0.29		<0.2-<1.2	<0.29	<0.28				<5	<5
Vanadium	0.036	1		6.3-59	6.9	7.5				<50	<50
Zinc	0.16	1		9.2-95	30	27				<50	<50

☐ CT&E Data.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks
					SW01	SW02	SW03	AB01	EB03	TB03	
Laboratory Sample ID Numbers					196/199 4268-3	200/203	204/207	4209-7 4214-6	192/195 4268-2	190 4268-1	#1&2-82093 4209 4214 4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	10	1,000		392[ad]-457J[ad]	<1,000[b]	<1,000J[b]	<1,000[b]	NA	<1,000[b]	NA	NA
GRPH	5	50		<20	<50J[b]	<50J[b]	70J[ab]	NA	<50J[b]	<50J[b]	<50
RRPH (Approx.)	100	1,000		NA	<1,000	<1,000	<1,000	NA	<1,000	NA	NA
BTEX (8020/8020 Mod.)											
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	24	<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	3	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	31J	<2	<2	<2	<2
HVOC 8010	0.1	1		NA	<1	<1	<1	NA	<1	<1	<1
VOC 8260	1	1-2.7		<1	<1-2.7U	NA	NA	<1	<1-3.3	<1	<1
SVOC 8270	10	22		<10	<22	NA	NA	NA	<22	NA	<10
PCBs	0.2	2	0.5	<1-<2	<2	<2J	<2	NA	<2	NA	NA
TOC	5,000	5,000		6,700-14,400	18,100J	NA	NA	NA	NA	NA	<5,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
d The laboratory reported that the EPH in this sample was pattern not consistent with a middle distillate fuel.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks
					SW01	SW02	SW03	AB01	EB03	TB03	
Laboratory Sample ID Numbers					196/199 4268-3	200/203	204/207	4209-7 4214-6	192/195 4268-2	190 4268-1	#1&2-82093 4209 4214 4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
TSS	100	100		6,000-9,000	35,000	NA	NA	NA	NA	NA	<100
TDS	10,000	10,000		212,000-352,000	3,912,000	NA	NA	NA	NA	NA	<10,000

☐ CT&E Data.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blank
					SW01						EB03	
Laboratory Sample ID Numbers					4268-3						4268-2	4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	300 (<100)						<100	<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)						<100	<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)						<100	<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	170 (150)						<50	<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)						<50	<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	85,000J (80,000)						<200	378 (378)
Chromium	32.9	50	100	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)						<100	<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blank
					SW01						EB03	
Laboratory Sample ID Numbers					4268-3						4268-2	4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Iron	25	100		180-2,800 (<100-1,600)	2,300 (200)						<100	<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)						<100	<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	59,000 (59,000)						<200	<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	360 (290)						<50	<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)						<50	<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)						<50	<50 (<50)
Potassium	1,154	5,000		<5,000 (5,000)	13,000 (14,000)						<5,000	<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)						<100	<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)						<50	<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	490,000 (460,000)						290	<250 (<250)

☐ CT&E Data.
N/A Not available.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blank
					SW01						EB03	
Laboratory Sample ID Numbers					4268-3						4268-2	4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Thallium	0.57	5	2	<5 (<5)	<5 (<5)						<5	<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)						<50	<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.

TABLE 3-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD LANDFILL (LF01)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Landfill (LF01)	Soil	GRPH	5J	mg/kg	<0.6-<1.00	--	--	100[c]	No
		Toluene	0.1	mg/kg	<0.030-<0.060	--	5,400	--	No
		Ethylbenzene	0.1	mg/kg	<0.030-<0.060	--	2,700	--	No
		Xylenes (total)	0.06J	mg/kg	<0.030-<0.120	--	54,000	--	No
		Tetrachloroethene	0.04	mg/kg	NA	1.23	270	--	No
		Trichloroethene	0.4J	mg/kg	NA	5.8	--	--	No
		Aroclor 1254	8.1J	mg/kg	<0.030-<0.100	0.0083	0.54	10[d]	**Yes**
		Aluminum	2,100	mg/kg	1,500-25,000	--	--	--	No
		Barium	130	mg/kg	27-390	--	1,890	--	No
		Calcium	4,800J	mg/kg	350-59,000	--	--	--	No
		Chromium	16	mg/kg	<4.3-47	--	135	--	No
		Copper	8.6	mg/kg	<2.7-45	--	--	--	No
		Iron	7,600	mg/kg	5,400-35,000	--	--	--	No
		Lead	69	mg/kg	<5.1-22	--	--	500[e]	No
		Magnesium	1,100	mg/kg	360-7,400	--	--	--	No
		Manganese	160	mg/kg	25-290	--	3,780	--	No
		Nickel	14	mg/kg	4.2-46	--	540	--	No
		Potassium	340	mg/kg	<300-2,200	--	--	--	No
		Sodium	1,000	mg/kg	<160-680	--	--	--	No
		Vanadium	7.5	mg/kg	6.3-59	--	189	--	No
		Zinc	30	mg/kg	9.2-95	--	8,100	--	No
	Surface Water[h]	GRPH	70J	µg/L	<20	50	730	--	**Yes**
		Toluene	24	µg/L	<1	--	96.5	1,000[f]	No
		Ethylbenzene	3	µg/L	<1	--	158	700[f]	No
		Xylenes (total)	31J	µg/L	<2	--	7,300	10,000[f]	No

TABLE 3-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD LANDFILL (LF01) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Landfill	Surface Water[h]	Aluminum	300	µg/L	<100-350	--	--	--	No
(LF01)	(Continued)	Barium	170	µg/L	<50-93	--	256	2,000[g]	No
(Continued)		Calcium	85,000J	µg/L	4,500-88,000	--	--	--	No
		Iron	2,300	µg/L	180-2,800	--	--	--	No
		Magnesium	59,000	µg/L	<5,000-53,000	--	--	--	No
		Manganese	360	µg/L	<50-510	--	18.3	--	No
		Potassium	13,000	µg/L	<5,000	--	--	--	No
		Sodium	490,000	µg/L	8,400-410,000	--	--	--	No

NA Not analyzed.
a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.
d TSCA Cleanup level.
e OSWER 1991.
f MCL, 56 FR 3526 (30 January 1991).
g MCL, 56 FR 30266 (01 January 1991).
h The concentrations reported for metals in surface water are total metals.
J Result is an estimate.

3.2 DUMP SITE (LF02)

3.2.1 Site Background

This site is west of the main station and east of the Old Landfill (LF01) and the Dock Storage Area (ST03). The three sites are all located west of the main installation and consist of gravel covered areas; the boundaries between the sites are not readily discernable. The Dump Site was active from the late 1970s to the 1980s. It is reported to have been cleaned up in 1987 (Dames and Moore 1987). Large debris was hauled to the new landfill because the Dump Site was being eroded by the Beaufort Sea.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.2.3.

3.2.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Dump Site site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.2.2.1 Summary of Samples Collected. Six samples were collected from gravel pads, tundra, ponds, and beach sands at the site. These consisted of four soil samples, one sediment sample, and one surface water sample. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Dump Site (LF02) site are presented in Figure 3-2.

Four soil samples were analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, and PCBs. In addition, one was analyzed for VOCs, SVOCs, and total metals.

One sediment sample was analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, PCBs, VOCs, SVOCs, and total metals.

One surface water sample was analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, PCBs, VOCs, SVOCs, total and dissolved metals, TDS, TSS, and TOC.

3.2.2.2 Analytical Results. The data summary table (Table 3-3) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-2. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or decontamination procedures. Only metals detected above background levels that exceed an RBSL or ARAR are presented on Figure 3-2. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Only one organic compound was detected at a very low concentration in soil/sediment samples collected at the site. Toluene was detected in soil sample LF02-S03-1.5 at 0.096 mg/kg.

No organic compound was detected in the surface water sample collected at the site.

Inorganics. Metals analyses indicated that two metals (manganese and sodium) were detected at a concentration above background levels in soil/sediment samples at the site. Manganese was detected at 410 mg/kg in sediment sample LF02-SD01/SD02, and sodium was detected at 980 mg/kg in soil sample LF02-S03-1.5.

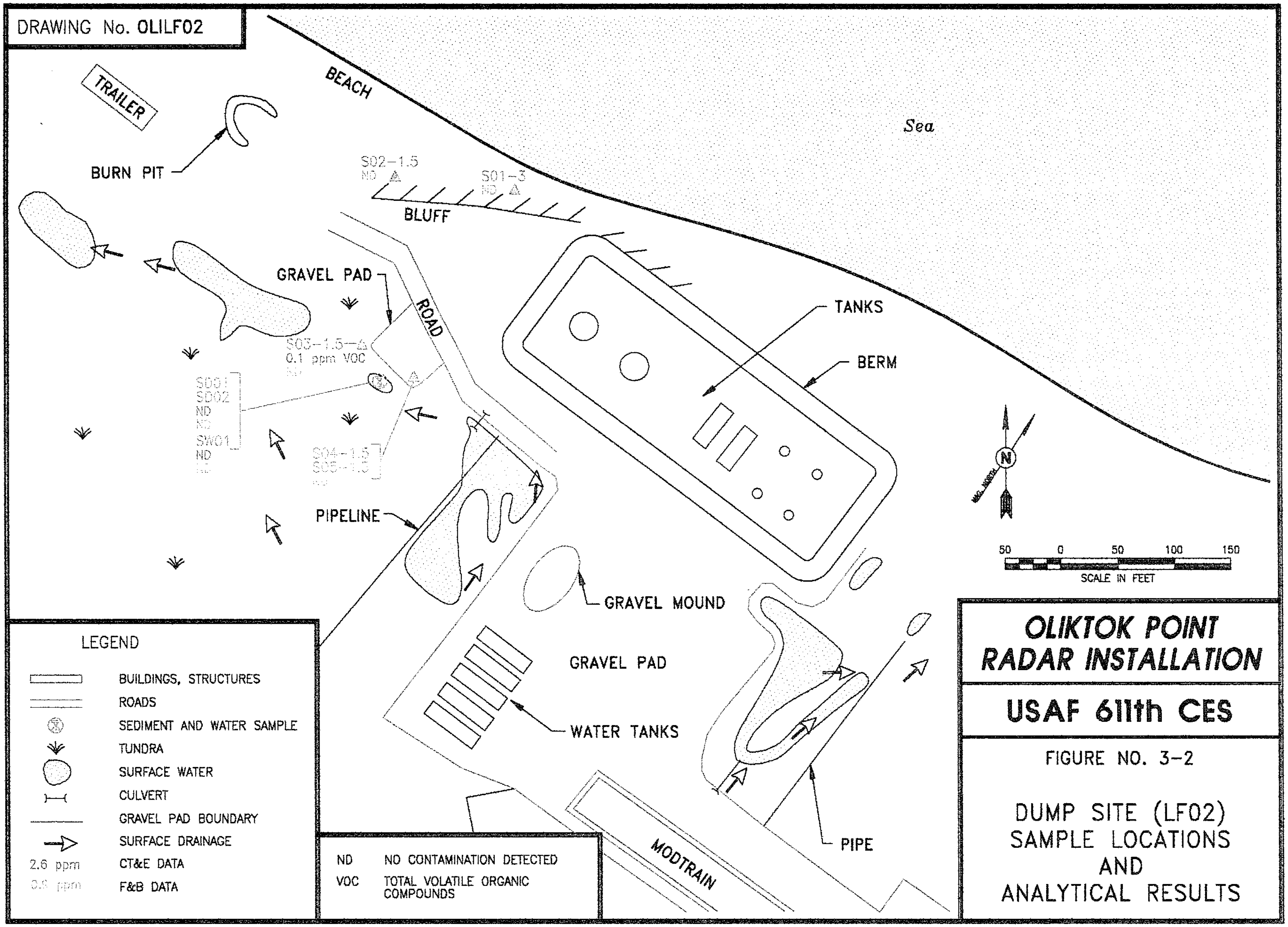
In the surface water sample, metals analyses detected one metal (barium) was detected at a level above the background concentration. Barium was detected at 200 μg/L in surface water sample LF02-SW01. TOC, TSS, and TDS were reported at 15,500; 12,000; and 726,000 μg/L, respectively, in surface water sample LF02-SW01.

3.2.2.3 Summary of Site Contamination. Sampling and analysis have determined that the Dump Site is not contaminated. The only organic compound detected was a very low level of toluene in the soil/sediment at the site. Metals detected in soil/sediment and surface water at the site were not detected at a level of concern. No previous sampling had been conducted at the site. In addition, no COC was identified for soil/sediment or surface water in the risk assessment. Therefore, migration pathways and risks to human health and the environment are not a concern because there is no significant contaminant to evaluate.

3.2.3 Conclusion and Recommendations

Sampling and analyses have determined that the Dump Site (LF02) is not contaminated. Only a very low level of toluene in one soil sample and metals that were not at a level of concern were detected at the site.

No significant contaminants were detected at the site, so there appears to be no potential for contaminant migration or risk to human health or ecological receptors. Based on the RI sampling and analyses and risk assessment, the Dump Site (LF02) is recommended for no further action.



DRAWING No. OLILF02
TRAILER
BURN PIT
BEACH
Sea
S02-1.5
ND
S01-3
ND
BLUFF
GRAVEL PAD
ROAD
S03-1.5
0.1 ppm VOC
SD01
SD02
ND
SW01
ND
S04-1.5
S05-1.5
PIPELINE
TANKS
BERM
GRAVEL MOUND
GRAVEL PAD
WATER TANKS
MODTRAIN
PIPE
50 0 50 100 150
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
ROADS
SEDIMENT AND WATER SAMPLE
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
F&B DATA
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
OLIKTOK POINT RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 3-2
DUMP SITE (LF02) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY

Installation: Oliktok Point
Site: Dump Site (LF02)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01-3	S02-1.5	S03-1.5	S04-1.5 & S05-1.5 (Replicates)		AB01	EB03	TB03		
Laboratory Sample ID Numbers					176/177	178/179	180/181 4267-7	186/187	188/189	4209-7 4214-6	192/195 4268-2	190 4268-1	#1&2-82093 4209/4214 4268	#5-81993 #1&2-82093 4267
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	13.8J[d]-167J[d]	<50[b]	<50[b]	<70[b]	<50[b]	<100[b]	NA	<1,000[b]	NA	NA	<50
GRPH	0.1-0.2	1-2	100	<0.600-<1.00	<1J[b]	<1J[b]	<1J[b]	<1[b]	<2J[b]	NA	<50J[b]	<50J[b]	<50	<1
RRPH (Approx.)	10	100	2,000[a]	NA	<100	<100	<100	<100	<100	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.10	<0.10	<0.15	<0.10	<0.20J					
Benzene	0.002-0.004	0.02-0.04	0.5	<0.030-<0.060	<0.02	<0.02	<0.03	<0.02	<0.04J	<1	<1	<1	<1	<0.02
Toluene	0.002-0.004	0.02-0.04		<0.030-<0.060	<0.02	<0.02	<0.03	<0.02	<0.04J	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.004	0.02-0.04		<0.030-<0.060	<0.02	<0.02	<0.03	<0.02	<0.04J	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.060-<0.120	<0.04	<0.04	<0.06	<0.04	<0.08J	<2	<2	<2	<2	<0.04
HVOC 8010	0.002-0.004	0.02-0.04		NA	<0.02	<0.02	<0.03	<0.02	<0.04J	NA	<1	<1	<1	<0.02
VOC 8260														
Toluene	0.020	0.070		<0.030-<0.045	NA	NA	0.096	NA	NA	<1	<1	<1	<1	<0.020
SVOC 8270	0.200	6.00		<0.330-<3.30	NA	NA	<6.00	NA	NA	NA	<22	NA	<10	<0.200
PCBs	0.01-0.02	0.1-0.2	10	<0.030-<0.100	<0.1	<0.1	<0.1	<0.1	<0.2	NA	<2	NA	NA	<0.01-<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point Matrix: Sediment
Site: Dump Site (LF02) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: SD01 & SD02 (Replicates)			Field Blanks: AB01	Field Blanks: EB03	Field Blanks: TB03	Lab Blanks	
Laboratory Sample ID Numbers					182/183 4267-8	184/185 4267-9		4209-7 4214-6	192/195 4268-2	190 4268-1	#1&2-82093 4209/4214 4268	#5-81993 #1&2-82093 4267
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	9-16	90-160	500[a]	13.8J[d]-167J[d]	<160[b]	<90[b]		NA	<1,000[b]	NA	NA	<50
GRPH	0.2-0.3	2-3	100	<0.600-<1.00	<3J[b]	<2J[b]		NA	<50J[b]	<50J[b]	<50	<1
RRPH (Approx.)	10	100	2,000[a]	NA	<100	<100		NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.31	<0.20						
Benzene	0.004-0.006	0.04-0.06	0.5	<0.030-<0.060	<0.06	<0.04		<1	<1	<1	<1	<0.02
Toluene	0.004-0.006	0.04-0.06		<0.030-<0.060	<0.06	<0.04		<1	<1	<1	<1	<0.02
Ethylbenzene	0.004-0.006	0.04-0.06		<0.030-<0.060	<0.06	<0.04		<1	<1	<1	<1	<0.02
Xylenes (Total)	0.008-0.013	0.08-0.13		<0.060-<0.120	<0.13	<0.08		<2	<2	<2	<2	<0.04
HVOC 8010	0.004-0.006	0.04-0.06		NA	<0.06	<0.04		NA	<1	<1	<1	<0.02
VOC 8260	0.020	0.040-0.065		<0.030-<0.045	<0.040	<0.065		<1	<1-3.3	<1	<1	<0.020
SVOC 8270	0.200	4.00-5.90		<0.330-<3.30	<4.00	<5.90		NA	<22	NA	<22	<0.200
PCBs	0.02-0.03	0.2-0.3	10	<0.030-<0.100	<0.3	<0.2		NA	<2	NA	NA	<0.01-<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point — Site: Dump Site (LF02) — Matrix: Soil/Sediment — Units: mg/kg — METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank	Lab Blanks
					S03-1.5	SD01 & SD02 (Replicates)				EB03	
Laboratory Sample ID Numbers					4267-7	4267-8	4267-9			4268-2	4267 4268
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	7,300J	4,400	6,900			<100	<100
Antimony	N/A	81-120		<7.8-<230	<120J	<81	<111			<100	<100
Arsenic	0.11	8.1-12		<4.9-8.5	<12	<8.1	<11			<100	<100
Barium	0.024	1		27-390	260	130	200			<50	<50
Beryllium	N/A	4.1-6.1		<2.6-6.4	<6.1	<4.1	<5.6			<50	<50
Cadmium	0.33	4.1-6.1		<3.0-<36	<6.1	<4.1	<5.6			<50	<50
Calcium	0.69	4		360-59,000	9,200J	7,100	11,000			<200	<200-378
Chromium	0.066	1		<4.3-47	12J	8.4J	12J			<50	<50
Cobalt	N/A	8.1-12		<5.1-12	<12	<8.1	<11			<100	<100
Copper	0.045	1		<2.7-45	9.1	7.7	16			<50	<50
Iron	0.50	2		5,400-35,000	13,000	9,800	17,000			<100	<100
Lead	0.13	2-12		<5.1-22	<12	<8.1	20			<100	<100
Magnesium	0.96	4		360-7,400	1,700	3,300	2,700			<200	<200
Manganese	0.025	1		25-290	100	120	410			<50	<50
Molybdenum	N/A	4.1-6.1		<2.5-<11	<6.1	<4.1	<5.6			<50	<50

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Dump Site (LF02)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank	Lab Blanks
					S03-1.5	SD01 & SD02 (Replicates)				EB03	
Laboratory Sample ID Numbers					4267-7	4267-8	4267-9			4268-2	4267 4268
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L
Nickel	0.11	1		4.2-46	11	11	16			<50	<50
Potassium	23	100-610		<300-2,200	<610	580	980			<5,000	<5,000
Selenium	1.2	2-111		<7.8-<170	<12	<8.1	<111			<100	<100
Silver	0.53	4.1-6.1		<3-<110	<6.1	<4.1	<5.6			<50	<50
Sodium	0.55	5		<160-680	980	350	660			290	<250
Thallium	0.011	0.26-0.61		<0.2-<1.2	<0.61	<0.26	<0.55			<5	<5
Vanadium	0.036	1		6.3-59	17	15	20			<50	<50
Zinc	0.16	1		9.2-95	20	33	84			<50	<50

☐ CT&E Data.

TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Dump Site (LF02)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample					Field Blanks			Lab Blanks
					SW01					AB01	EB03	TB03	
Laboratory Sample ID Numbers					212/215 4268-4					4209-7 4214-6	192/195 4268-2	190 4268-1	#1&2-82093 4209/4214 4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L	µg/L	µg/L
DRPH	50	500		392[ad]-457J[ad]	<1,000[b]					NA	<1,000[b]	NA	NA
GRPH	5	50		<20	<50J[b]					NA	<50J[b]	<50J[b]	<50
RRPH (Approx.)	100	1,000		NA	<1,000					NA	<1,000	NA	NA
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1					<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1					<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1					<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2					<2	<2	<2	<2
HVOC 8010	0.1	1		NA	<1					NA	<1	<1	<1
VOC 8260	1	1.6		<1	<1-1.6U					<1	<1-3.3	<1	<1
SVOC 8270	10	22		<10	<22					NA	<22	NA	<10

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a Total petroleum hydrocarbons in these water samples exceed the 15 µ/gL stated for fresh water in ADEC's water Quality Criteria 18AAC70 (ADEC 1989).
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point Matrix: Surface Water
Site: Dump Site (LF02) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample					Field Blanks			Lab Blanks
					SW01					AB01	EB03	TB03	
Laboratory Sample ID Numbers					212/215 4268-4					4209-7 4214-6	192/195 4268-2	190 4268-1	4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L	µg/L	µg/L
PCBs	0.2	2	0.5	<1-<2	<2					NA	<2	NA	NA
TOC	5,000	5,000		6,700-14,400	15,500J					NA	NA	NA	<5,000
TSS	100	100		6,000-9,000	12,000					NA	NA	NA	<100
TDS	10,000	10,000		212,000-352,000	726,000					NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point Matrix: Surface Water METALS ANALYSES: TOTAL (DISSOLVED)
Site: Dump Site (LF02) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blank
					SW01						EB03	
Laboratory Sample ID Numbers					4268-4						4268-2	4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	180 (<100)						<100	<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)						<100	<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)						<100	<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	200 (190)						<50	<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)						<50	<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	67,000J (64,000)						<200	378 (378)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)						<100	<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Dump Site (LF02)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blank
					SW01						EB03	
Laboratory Sample ID Numbers					4268-4						4268-2	4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Iron	25	100		180-2,800 (<100-1,600)	920 (200)						<100	<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)						<100	<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	26,000 (26,000)						<200	<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	62 (<50)						<50	<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)						<50	<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)						<50	<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (5,100)						<5,000	<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)						<100	<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)						<50	<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	95,000 (100,000)						290	<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)						<5	<5 (<5)

☐ CT&E Data.
N/A Not available.

TABLE 3-3. DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Dump Site (LF02)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blank
					SW01						EB03	
Laboratory Sample ID Numbers					4268-4						4268-2	4268
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Vanadium	1.8	50		<50 (<50)	<50 (<50)						<50	<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.

TABLE 3-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE DUMP SITE (LF02)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Dump Site (LF02)	Soil	Toluene	0.096	mg/kg	<0.030-<0.045	--	5,400	--	No
		Aluminum	7,300J	mg/kg	1,500-25,000	--	--	--	No
		Barium	260	mg/kg	27-390	--	1,890	--	No
		Calcium	11,000	mg/kg	360-59,000	--	--	--	No
		Chromium	12J	mg/kg	<4.3-47	--	135	--	No
		Copper	16	mg/kg	<2.7-45	--	--	--	No
		Iron	17,000	mg/kg	5,400-35,000	--	--	--	No
		Lead	20	mg/kg	<5.1-22	--	--	500[c]	No
		Magnesium	3,300	mg/kg	360-7,400	--	--	--	No
		Manganese	410	mg/kg	25-290	--	3,780	--	No
		Nickel	16	mg/kg	4.2-46	--	540	--	No
		Potassium	980	mg/kg	<300-2,200	--	--	--	No
		Sodium	980	mg/kg	<160-680	--	--	--	No
		Vanadium	20	mg/kg	6.3-59	--	189	--	No
		Zinc	84	mg/kg	9.2-95	--	8,100	--	No
	Surface Water[e]	Aluminum	180	µg/L	<100-350	--	--	--	No
		Barium	200	µg/L	<50-93	--	256	2,000[d]	No
		Calcium	67,000J	µg/L	4,500-88,000	--	--	--	No
		Iron	920	µg/L	180-2,800	--	--	--	No
		Magnesium	26,000	µg/L	<5,000-53,000	--	--	--	No
		Manganese	62	µg/L	<50-510	--	18.3	--	No
		Potassium	5,100	µg/L	<5,000	--	--	--	No
		Sodium	95,000	µg/L	8,400-410,000	--	--	--	No

TABLE 3-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE DUMP SITE (FF02) (CONTINUED)

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c U.S. EPA 1991c.
d MCL, 56 FR 30266 (01 January 1991).
e The concentrations reported for metals in surface water are total metals.
J Result is an estimate.

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3.3 DOCK STORAGE AREA (ST03)

3.3.1 Site Background

The Dock Storage Area is located west of the POL tanks, east of the Old Landfill (LF01), and west of the Dump Site (LF02). The site is approximately one-half acre in size and consists of a gravel covered area. The site was used for storage of drummed liquids, and drums were removed from the site prior to 1987 (Woodward-Clyde 1987).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.3.3.

3.3.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Dock Storage Area (ST03) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.3.2.1 Summary of Samples Collected. Five samples were collected from the gravel pad, tundra, beaches, and ponds at this site. These consisted of three soil samples, one sediment sample, and one surface water sample. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Dock Storage Area (ST03) site are presented in Figure 3-3.

Four soil samples were analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, and PCBs. In addition, one soil sample was analyzed for VOCs and SVOCs.

One sediment sample was analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, PCBs, VOCs, and SVOCs.

One surface water sample was analyzed for DRPH, GRPH, BTEX, PCBs, pesticides, VOCs (8010 and 8260), SVOCs, total and dissolved metals, TDS, TSS, and TOC.

3.3.2.2 Analytical Results. The data summary table (Table 3-5) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-3. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. Only metals detected above background levels that exceed an RBSL or ARAR are presented on Figure 3-3. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil/sediment samples collected at the site include DRPH, ethylbenzene, xylenes, and PCBs. DRPH, ethylbenzene, and xylenes were detected in replicate soil sample ST03-S01-0.8/S05-0.8 at 300, 0.02, and 0.08 mg/kg, respectively. PCBs (Aroclor 1254) were detected at 0.3 mg/kg in soil sample ST03-S02.

In surface water sample ST03-SW01, organic compounds detected were limited to DRPH (806 mg/kg) and 1,2-dichloroethane (1.9 mg/kg).

Inorganics. Metals analyses indicated that five metals (barium, calcium, magnesium, potassium, and sodium) were detected above background levels in surface water sample ST03-SW01. Barium, calcium, magnesium, potassium, and sodium were detected at 250; 100,000; 85,000; 20,000; and 590,000 μg/L, respectively. TOC, TSS, and TDS were reported at 20,400; 29,000; and 2,484,000 μg/L, respectively, in the surface water sample.

3.3.2.3 Summary of Site Contamination. Sampling and analyses have determined that low levels of DRPH and VOCs exist in soil and surface water, and very low levels of PCBs exist in soil at the site. Metals detected in surface water at the site were not detected at a level of concern. No previous sampling had been conducted at the site. The suspected source of contaminants detected during sampling conducted at the Dock Storage Area is fuel spills and/or leaks associated with the Old Sewage Area Petroleum Spill (SS11). The Dock Storage Area is located downgradient from the Old Sewage Area Petroleum Spill site, and contaminants detected at the site are similar. The human health and ecological risks associated with chemicals detected at the site are presented in Section 3.3.4 and 3.3.5.

3.3.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.3.3.1 Topography and Stratigraphy. The site consists of a well-graded gravel pad/road placed on the tundra adjacent to the beach (Figure 3-3). The topography in this area is generally flat. The gravel pad and road, which are approximately one foot thick, provide the greatest topographic relief at the site. Drainage from the site is generally radial, away from the gravel pad/road.

During the 1993 RI, permafrost was located at a depth of approximately two feet in tundra areas and four feet under gravel pads. Gravel pads consisted of the typical gravels and sands, and subsurface tundra materials were of the typical stratigraphy associated with these features (Section 2.4.4.2). Along the beach, surface and subsurface materials consisted of the typical sands, gravels, and fine materials associated with these features.

3.3.3.2 Migration Potential.

Subsurface Migration. Although the flat and marshy topography indicates sluggish subsurface flow in the area, analytical results indicate that petroleum compounds have migrated in the

subsurface. The site is downgradient of part of the Old Sewage Area Petroleum Spill and similar contaminants were detected, although at lower concentrations.

Surface Migration. The primary route of surface migration over the tundra is through sluggish ephemeral streams, and the primary route of surface migration over the gravel and beach portions of the site is overland sheet flow. Significant surface migration is probably limited to spring thaw when large quantities of meltwater are available and the frozen ground prevents active layer water flow. The slightly raised gravel road at the site prevents significant surface water migration from the tundra to the beach. Surface water in the tundra will flow west towards the Old Landfill (LF01) and estuary. The DRPH detected in the surface water indicate that there is a potential for surface migration of contaminants.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Analytical data indicate that subsurface soil and surface water at the site have been affected by low levels of contaminants (primarily DRPH). The contaminants detected are similar but at lower concentrations to those detected at the upgradient Old Sewage Area Petroleum Spill site. Although the potential for contaminant migration exists, the surrounding topography indicates relatively sluggish flow in the area. Therefore, the potential for surface and subsurface contaminant migration is limited.

3.3.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Dock Storage Area (ST03) site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, incidental ingestion of soil/sediment, and ingestion of surface water. Because ground water and air at the Oliktok Point sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Oliktok Point Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The risk estimates for native adults and children were based on a potential future residential scenario (i.e., the installation is released for civilian use). The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with chemicals at the site are presented in Section 3.3.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Oliktok Point Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Oliktok Point installation. Because of the diversity of the plants and animals in the area of the Oliktok Point installation, a set of representative species

was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Tables 2-6 and 2-7.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Oliktok Point. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.3.5.

3.3.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Dock Storage Area (ST03) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.3.4.1 Chemicals of Concern. Aroclor 1254 was identified as a COC for the soil matrix at the Dock Storage Area because concentrations exceeded background levels and the RBSL based on cancer risk.

DRPH and 1,2-dichloroethane were identified as COCs for the surface water matrix at the site. The maximum concentrations of DRPH exceeded background concentrations and the RBSLs based on noncancer hazard. 1,2-Dichloroethane exceeded the background concentration and the RBSL based on cancer risk.

Table 3-6, Identification of COCs at the Dock Storage Area (ST03), presents the maximum concentrations of chemicals detected at the site, the associated background concentrations, RBSLs, and ARARs, and the COCs selected in the risk evaluation.

3.3.4.2 Exposure Pathways and Potential Receptors. Because COCs were identified for soil/sediment and surface water at the site, the potential risks associated with ingestion of soil/sediment and surface water were evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

3.3.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Dock Storage Area by a hypothetical native northern adult/child is 0.02, and by a DEW Line worker is 0.001, based on the maximum concentration of the COC. The presence of Aroclor 1254 accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the Dock Storage Area by a hypothetical native northern adult/child is 4×10^{-7}, and by a DEW Line worker is 2×10^{-8}, based on the maximum concentration of the COC. The presence of Aroclor 1254 accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the Dock Storage Area (ST03) site by a hypothetical native northern adult or by a DEW Line worker is 0.1, based on the maximum concentrations of the COC. DRPH account entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at this site by a native northern adult is 2×10^{-6}, and by a DEW Line worker is 3×10^{-7}, based on the maximum concentrations of the COC. The presence of 1,2-dichloroethane accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

3.3.4.4 Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Dock Storage Area (ST03) are the very low noncancer hazards (hazard indices of 0.02 and 0.001), and low cancer risk associated with Aroclor 1254. These risks and hazards were calculated conservatively based ingestion of soil at a rate associated with a potential future residential scenario. It is very unlikely that the soil at this location would be ingested at the conservative rate used in the risk calculation, and the hazards and risks at the site are likely to be overestimated.

A hazard index of 0.1 is associated with DRPH in surface water at the site indicating a minimal noncancer risk. The cancer risk associated with 1,2-dichloroethane in surface water for the native adult is 2×10^{-6}, and for a DEW Line worker is 3×10^{-7}. The potential risks and hazards were calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the chemicals in surface water do not currently pose a health hazard nor are they likely to pose a hazard in the future. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not known to be used as a water supply now, nor has it been used in the past. Remedial action is generally not warranted at sites where the excess lifetime cancer risk is less than 1×10^{-4} and the noncancer hazards do not exceed one (EPA 1991b), and on the basis of the risk assessment remediation of the site is not warranted.

In conclusion, under current or future site uses, the COCs identified in soil/sediment and surface water at the Dock Storage Area (ST03) site pose only a minimal, if any, potential threat to human health. The cancer risks and noncancer hazards are below levels at which remediation is usually required. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.3.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the Oliktok Point installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.3.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. All sites at the installation were considered as potentially usable habitat. It should be noted that the COC selection process only considered the soil/sediment samples that were at or less than 1.5 feet deep. The soil/sediment samples were screened for depth because it is unlikely that any of the representative species will be exposed to soils/sediments deeper than 1.5 feet. DRPH were identified as a COC in surface water at the Dock Storage Area site, and DRPH, ethylbenzene, xylenes, and PCBs were considered COCs in soil/sediment. The identified COCs were not associated with significant risk estimates at the Dock Storage Area site.

3.3.5.2 Summary of Ecological Risk Assessment. Based on the quantification of potential risks to ecological receptors and discussions presented in the Oliktok Point ERA, ecological risks at the Dock Storage Area site are not significant. There is a possibility that PCBs may bioaccumulate in the food chain. Although PCB concentrations do not currently pose a significant risk, they may present a risk to ecological receptors in the future as a result of potential bioaccumulation; however, given the low level of PCBs detected in only one site sample, the potential risk is low.

3.3.6 Conclusions and Recommendations

Sampling and analyses have determined that low levels of contaminants (primarily DRPH) were detected at the Dock Storage Area (ST03). Only low levels of contaminants were detected in soil/sediment and surface water. The source, although unknown, is suspected to be migration from spills and/or leaks associated with the Old Sewage Area Petroleum Spill (SS11). It is also possible that isolated spills and/or leaks caused by previous drum storage activities at the site could be a source. The site is presently inactive, so there is no longer a contaminant source at the site. Analytical data indicate that migration of contaminants from the site is minimal.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. The potential hazards and risks are based on a future scenario in which the site surface water would be used as a sole-source drinking water supply. Even using the conservative future scenario, the potential risks at the site are not of a magnitude that normally requires remedial action.

Based on the RI sampling and analyses and the risk assessment, remedial actions are not warranted at the site. No significant human health or ecological risk was identified at the site. Therefore, the Dock Storage Area (ST03) site is recommended for no further action.

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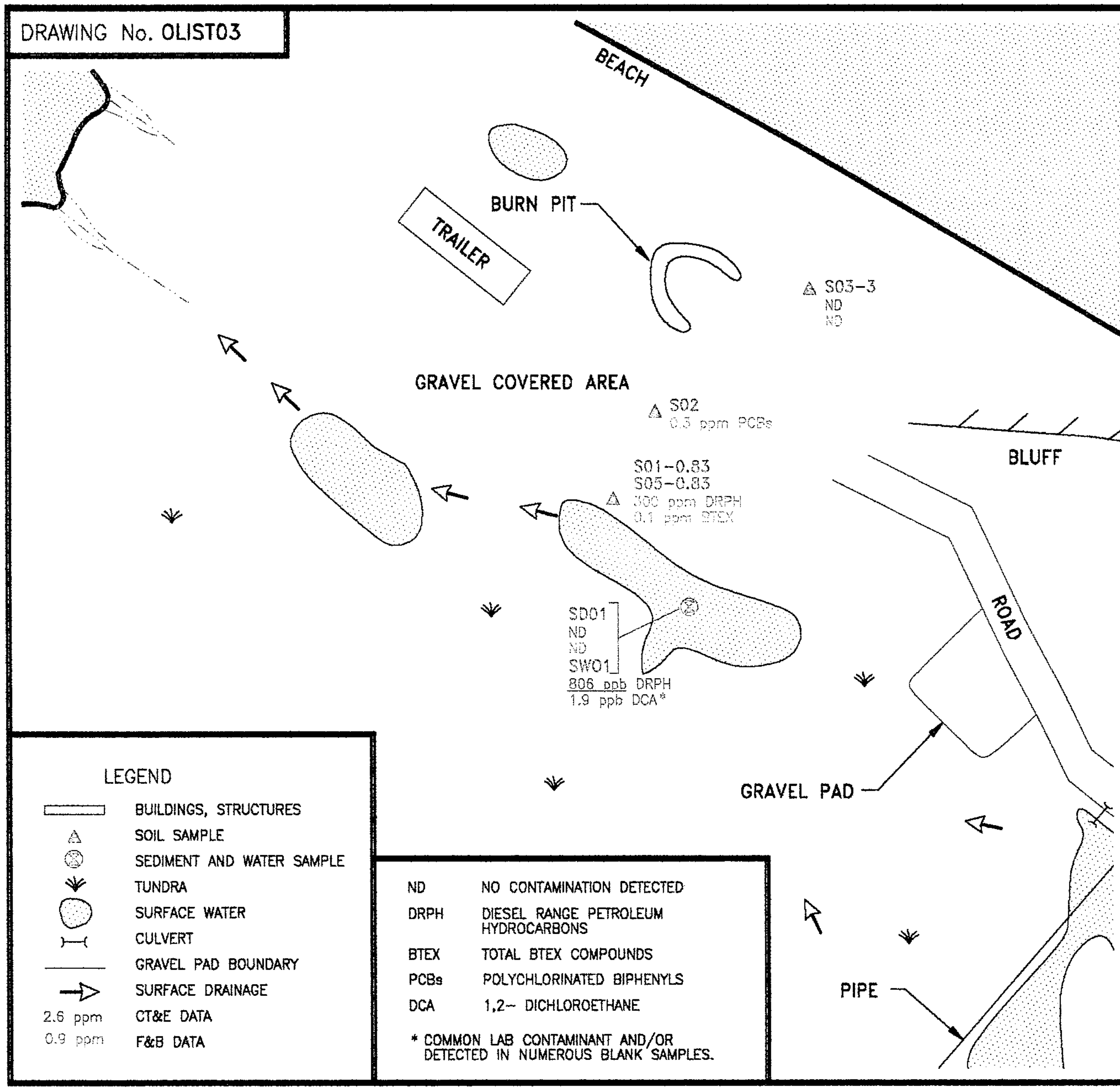

OLIKTOK POINT RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 3-3

DOCK STORAGE AREA (ST03) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-5. DOCK STORAGE AREA ANALYTICAL DATA SUMMARY

Installation: Oliktok Point
Site: Dock Storage Area (ST03)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: S01-0.8 & S05-0.8 (Replicates)		Environmental Samples: S02	Environmental Samples: S03-3	Environmental Samples: SD01	Field Blanks: AB01	Field Blanks: EB03	Field Blanks: TB03	Lab Blanks	
Laboratory Sample ID Numbers					174/175	210/211	172/173	208/209 4267-6	216/217 4267-6	4209-7 4214-6	192/195 4268-2	190 4268-1	#1&2-82093 4209 4214 4268	#5-82093 #5-81993 #1&2-82093 4267
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-6	50-60	500[a]	13.8J[d]-167J[d]	300[b]	80[b]	<50[b]	<60[b]	<50[b]	NA	<1,000[b]	NA	NA	<50
GRPH	0.1-0.2	1-2	100	<0.600-<1.00	<1J[b]	<1J[b]	<1J[b]	<1J[b]	<2J[b]	NA	<50J[b]	<50J[b]	<50	<1
RRPH (Approx.)	10	100	2,000[a]	NA	<100	<100	<100	<100	<100	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	0.06J	0.08J	<0.10	<0.10	<0.20					
Benzene	0.002-0.004	0.02-0.04	0.5	<0.030-<0.060	<0.02	<0.02	<0.02	<0.02	<0.04	<1	<1	<1	<1	<0.02
Toluene	0.002-0.004	0.02-0.04		<0.030-<0.060	<0.02	<0.02	<0.02	<0.02	<0.04	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.004	0.02-0.04		<0.030-<0.060	0.02	<0.02	<0.02	<0.02	<0.04	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.060-<0.120	0.04J	0.08J	<0.04	<0.04	<0.08	<2	<2	<2	<2	<0.04
HVOC 8010	0.002-0.004	0.02-0.04		<0.030-<0.060	<0.02	<0.02	<0.02	<0.02	<0.04	NA	<1	<1	<1	<0.02
VOC 8260	0.020	0.030-0.045		<0.030-<0.045	NA	NA	NA	<0.030	<0.045	<1	<1-3.3	<1	<1	<0.020
SVOC 8270	0.200	0.270-3.50		<0.330-<3.30	NA	NA	NA	<0.270-<1.50	<3.50	NA	<22	NA	<10	<0.900
PCBs														
Aroclor 1254	0.01-0.02	0.1-0.2	10	<0.030-<0.100	<0.1	<0.1J	0.3J	<0.1	<0.2	NA	<2	NA	NA	<0.01

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-5. DOCK STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Dock Storage Area (ST03)
Matrix: Surface Water
Units: μg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01				AB01	EB02	TB02	
Laboratory Sample ID Numbers					4209-12 4210-9 4217-16	4214-8			4209-7 4214-6	4209-6 4214-5	4209-11 4214-7	4209, 4217 4214, 4209 4210
ANALYSES	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L			μg/L	μg/L	μg/L	μg/L
DRPH	100	100		392[ad]-457J[ad]	806[ad]	282[ad]			NA	NA	NA	<100
GRPH	20	20		<20	<20	<20			NA	<20	NA	<20
BTEX (8020/8020 Mod.)												
Benzene	1	1	5	<1	<1	<1			<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	<1			<1	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	<1			<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	<2			<2	<2	<2	<2
VOC 8010	1	1		<1	<1	<1			<1	<1	<1	<1
VOC 8260												
1,2-Dichloroethane	1	1	5	<1	1.9	NA			<1	<1	<1	<1
SVOC 8270	10	10-14		<10	<14	<10-<10.5			NA	<10J	NA	<10
Pesticides	0.05	0.1-3		<0.1-<2	<0.3-<3	<0.1-<1			NA	NA	NA	<0.1-<1
PCBs	1	1-3	0.5	<1-<2	<3	<1			NA	NA	NA	<1
TOC	5,000	5,000		6,700-14,400	20,400	NA			NA	NA	NA	<5,000
TSS	100	100		6,000-9,000	29,000	NA			NA	NA	NA	<100
TDS	10,000	10,000		212,000-352,000	2,484,000	NA			NA	NA	NA	<10,000

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a Total petroleum hydrocarbons in these water samples exceed the 15 μg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-5. DOCK STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Dock Storage Area (ST03)
Matrix: Surface Water
Units: $\mu g/L$
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blanks
					SW01						EB02	
Laboratory Sample ID Numbers					4209-12 4210-9						4210-3	4210 4209
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	270 (150)						<100 (<100)	<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)						<100 (<100)	<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)						<100 (<100)	<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	250 (240)						<50 (<50)	<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)						<50 (<50)	<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)						<50 (<50)	<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	100,000 (100,000)						230 (<200)	<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)						<50 (<50)	<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)						<100 (<100)	<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)						<50 (<50)	<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 3-5. DOCK STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Dock Storage Area (ST03)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blanks
					SW01						EB02	
Laboratory Sample ID Numbers					4209-12 4210-9						4210-3	4210 4209
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Iron	25	100		180-2,800 (<100-1,600)	1,000 (210)						<100 (<100)	792 (792)
Lead	6.6	100	15	<100 (<100)	<100 (<100)						<100 (<100)	<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	85,000 (85,000)						<200 (<200)	<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	130 (100)						<50 (<50)	<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)						<50 (<50)	<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)						<50 (<50)	82 (82)
Potassium	1,154	5,000		<5,000 (<5,000)	20,000 (21,000)						<5,000 (<5,000)	<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)						<100 (<100)	<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)						<50 (<50)	<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	590,000 (530,000)						570 (500)	<250 (<250)

☐ CT&E Data.
N/A Not available.

TABLE 3-5. DOCK STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Dock Storage Area (ST03)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blanks
					SW01						EB02	
Laboratory Sample ID Numbers					4209-12 4210-9						4210-3	4210 4209
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Thallium	0.57	5	2	<5 (<5)	<5 (<5)						<5 (<5)	<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)						<50 (<50)	<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)						<50 (<50)	<50 (<50)

☐ CT&E Data.

TABLE 3-6. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE DOCK STORAGE AREA (ST03)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Dock Storage Area (ST03)	Soil	DRPH	300	mg/kg	13.8J-167J	--	--	500[c]	No
		Ethylbenzene	0.02	mg/kg	<0.030-<0.060	--	2,700	--	No
		Xylenes (Total)	0.08J	mg/kg	<0.060-<0.120	--	54,000	--	No
		Aroclor 1254	0.3J	mg/kg	<0.030-<0.100	0.0083	0.54	10[d]	**Yes**
	Surface Water[g]	DRPH	806	µg/L	392-457J	--	292		**Yes**
		1,2-Dichloroethane	1.9	µg/L	<1	0.934	--	5[e]	**Yes**
		Aluminum	270	µg/L	<100-350	--	--	--	No
		Barium	250	µg/L	<50-93	--	256	2,000[f]	No
		Calcium	100,000	µg/L	4,500-88,000	--	--	--	No
		Iron	1,000	µg/L	180-2,800	--	--	--	No
		Magnesium	85,000	µg/L	<5,000-53,000	--	--	--	No
		Manganese	130	µg/L	<50-510	--	18.3	--	No
		Potassium	20,000	µg/L	<5,000	--	--	--	No
		Sodium	590,000	µg/L	8,400-410,000	--	--	--	No

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.
d TSCA Cleanup level.
e MCL, 52 FR 25690 (08 July 1987).
f MCL, 56 FR 30266 (01 January 1991).
g The concentrations reported for metals in surface water are total metals.
J Result is an estimate.

3.4 POL STORAGE (ST04)

3.4.1 Site Background

The POL Storage site is a gravel pad area located northeast of the hangar and south of the installation airstrip. The gravel pad is approximately 200 feet by 100 feet and adjoins the gravel road leading to the hangar. The storage pad has been identified by previous IRP contractors as Site 19. Currently, a weather monitoring station is constructed on the site. Drummed POL products were reportedly stored at the site until 1987 (Woodward-Clyde 1987).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.4.3.

3.4.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the POL Storage (ST04) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.4.2.1 Summary of Samples Collected. Three soil samples were collected from the gravel pad at the site. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the POL Storage (ST04) site are presented in Figure 3-4.

The three soil samples were analyzed for DRPH, GRPH, and BTEX. In addition, one sample was analyzed for VOCs.

3.4.2.2 Analytical Results. The data summary table (Table 3-7) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-4. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds detected above background levels at the site.

Organics. Organic compounds detected in soil samples at the site include very low levels of GRPH, toluene, and xylenes. GRPH, toluene, and xylenes were detected in soil sample ST04-S03-1.5 at 1.03; 0.054; and 0.097 mg/kg, respectively.

Inorganics. Metals were not a concern at this site, and no metals analyses were performed.

3.4.2.3 Summary of Site Contamination. No significant levels of contaminants were detected at the site. Only very low levels of GRPH, toluene, and xylenes were detected in one soil sample. The human health and ecological risks associated with chemicals detected at the site are presented in Section 3.4.4 and 3.4.5. The suspected source of the very low levels of contaminants detected during sampling conducted at the POL Storage is fuel spills and/or leaks from previous drum storage activities.

3.4.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.4.3.1 Topography and Stratigraphy. The site consists of a gravel pad adjacent to the north side of the gravel road, placed on relatively flat tundra. The gravel pad, which is approximately four feet thick, provides the greatest topographic relief at the site. Although the topography in the area is relatively flat, the tundra in the area drains through a series of ephemeral streams generally towards the west.

During the 1993 RI, permafrost was located at a depth of approximately two feet in tundra areas and four feet under gravel pads. Gravel pads consisted of the typical gravels and sands, and subsurface tundra materials were of the typical stratigraphy associated with these features (Section 2.4.4.2).

3.4.3.2 Migration Potential.

Subsurface Migration. Except for very low levels of GRPH, toluene, and xylenes detected in one soil sample, no analytes were detected in soil samples collected at the site. Contaminants do not appear to be migrating from this site. Based upon these results, the potential for subsurface migration of contaminants is considered to be limited.

Surface Migration. No surface water bodies were present at the site during the field investigation. The lack of drainage pathways indicates that the primary route of surface migration is overland sheet flow. Significant surface migration at the site is probably restricted to the spring thaw when large quantities of meltwater are available and the frozen ground prevents active layer flow. However, analytical results indicate contaminant migration is not a concern. Based upon this, the potential for contaminant migration is considered to be limited.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. The flat topography and lack of significant contamination detected in soil samples indicate that the potential for surface and subsurface migration of contaminants at the site is limited.

3.4.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the POL Storage (ST04) site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, and incidental ingestion of soil/sediment. Surface water was not considered a route of exposure at the site because no surface waters are associated with the site. Because ground water and air at the Oliktok Point sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Oliktok Point Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The risk estimates for native adults and children were based on a potential future residential scenario (i.e., the installation is released for civilian use). The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with chemicals at the site are presented in Section 3.4.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Oliktok Point Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Oliktok Point installation. Because of the diversity of the plants and animals in the area of the Oliktok Point installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Tables 2-6 and 2-7.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Oliktok Point. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.4.5.

3.4.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the POL Storage (ST04) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway evaluated, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.4.4.1 Chemicals of Concern. No COCs were identified for the soil/sediment matrices at the POL Storage site based on a comparison of the maximum concentrations of detected chemicals to their background concentrations, RBSLs, and ARARs. No surface water bodies were identified at the site; therefore, no surface water COC has been identified.

Table 3-8, Identification of COCs at the POL Storage (ST04), presents the maximum concentrations of chemicals detected at the site, the associated background concentrations, RBSLs, and ARARs.

3.4.4.2 Summary of Human Health Risk Assessment. There were no COCs identified in the soil/sediment matrices at the POL Storage site, and no surface water bodies were identified at the site. Therefore, there were no COCs to evaluate. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.4.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the Oliktok Point installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.4.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. All sites at the installation were considered as potentially usable habitat. It should be noted that the COC selection process only considered the soil/sediment samples that were at or less than 1.5 feet deep. The soil/sediment samples were screened for depth because it is unlikely that any of the representative species will be exposed to soils/sediments deeper than 1.5 feet. No surface waters were identified at the site; therefore no surface water COC has been identified. Toluene and xylenes were identified as COCs in soil/sediment at the POL Storage site. None of the COCs identified were associated with significant risk estimates under current conditions at the POL Storage site.

3.4.5.2 Summary of Ecological Risk Assessment. Based on the quantification of potential risks to ecological receptors and discussions presented in the Oliktok Point ERA, ecological risks at the POL Storage site are not significant.

3.4.6 Conclusions and Recommendations

Sampling and analyses have determined that there is no significant contamination at the POL Storage (ST04) site. Only relatively low levels of contaminants were detected. Their source is

suspected to be spills and/or leaks from previous drum storage activities. The POL Storage is presently used as a weather monitoring station; drums are no longer stored at the site.

There does not appear to be any significant migration of contaminants from the site based on the soil samples collected at the site. In addition, there were no COCs identified for soil/sediment in the human health risk assessment, and none of the COCs identified in the ERA were associated with significant risk estimates at the site. Therefore, risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses.

Based on the RI sampling and analyses, risk assessment, and current or future site uses, remedial actions are not warranted at the site. No significant human health or ecological risks were identified at the site. Therefore, the POL Storage (ST04) site is recommended for no further action.

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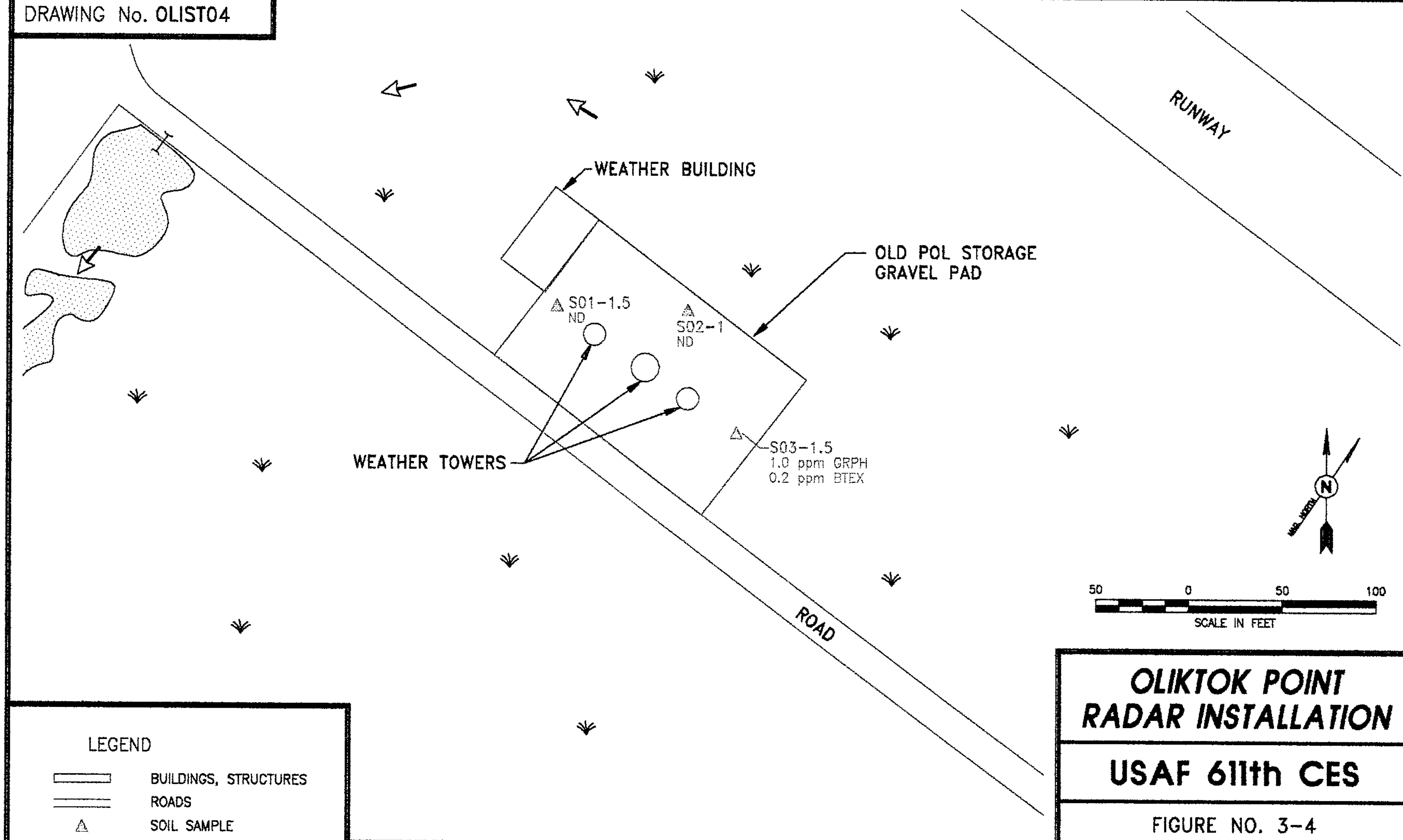

LEGEND

- BUILDINGS, STRUCTURES
- ROADS
- SOIL SAMPLE
- TUNDRA
- SURFACE WATER
- CULVERT
- GRAVEL PAD BOUNDARY
- SURFACE DRAINAGE
- 2.6 ppm CT&E DATA

ND	NO CONTAMINATION DETECTED
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS

OLIKTOK POINT RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 3-4

POL STORAGE (ST04) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-7. POL STORAGE ANALYTICAL DATA SUMMARY

Installation: Oliktok Point
Site: POL Storage (ST04)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					S01-1.5	S02-1	S03-1.5	AB01	EB02	TB02		
Laboratory Sample ID Numbers					4209-1 4217-1	4217-2	4217-5	4209-7 4214-6	4209-6 4214-5	4209-11 4214-7	4209 4214	4217 4209
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	13.8J[d]-167J[d]	<4.00	<4.00	<4.00	NA	NA	NA	NA	<4.00
GRPH	0.400	0.400-0.500	100	<0.600-<1.00	<0.400	<0.500	1.03	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.100	<0.125	0.151					
Benzene	0.020	0.020-0.025	0.5	<0.030-<0.060	<0.020	<0.025	<0.025	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.025		<0.030-<0.060	<0.020	<0.025	0.054	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.025		<0.030-<0.060	<0.020	<0.025	<0.025	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.050		<0.060-<0.120	<0.040	<0.050	0.097	<2	<2	<2	<2	<0.040
VOC 8260	0.020	0.020		<0.030-<0.045	<0.020	NA	NA	<1	<1	<1	<1	<0.020

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-8. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE POL STORAGE (ST04)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
POL Storage (ST04)	Soil	GRPH	1.03	mg/kg	<0.600-<1.00	--	--	100[c]	No
		Toluene	0.054	mg/kg	<0.030-<0.060	--	5,400	--	No
		Xylenes (Total)	0.097	mg/kg	<0.060-<0.120	--	54,000	--	No

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.

4.0 REMEDIAL INVESTIGATION - REMEDIAL ACTION SITES

This section of the RI/FS presents results from RI sampling and analysis activities for each of the four Oliktok Point sites where remedial action may be warranted. The four sites considered for remedial action and discussed in this section are the Diesel Spill (SS05), Gasoline Storage Area (ST08), Garage (SS10), and Old Sewage Area Petroleum Spill (SS11). Each of the sites is presented individually in Sections 4.1 through 4.4. (Note: figures and tables are presented at the end of each section.) The information presented for each site includes site background, field sampling and analytical results, potential migration pathways, human health and ecological risk assessment summaries, and conclusions and recommendations. The site-by-site discussions in this section are intended to provide the reader with all information needed to understand the site conditions and make decisions regarding appropriate action for each of the sites.

Photographs of the Oliktok Point installation and the sites investigated during the RI are presented in Appendix B. Data tables in this section list analytical results from samples in which chemicals were detected above quantitation limits. Complete laboratory analytical data sheets for each sample, including quantitation limits for non-detected analytes, are presented in Appendix F.

4.1 Diesel Spill (SS05)

4.1.1 Site Background

The Diesel Spill area is on the east side of the hangar and has been referred to in previous IRP documents as Site 20. It is the site of an approximately 300-gallon diesel fuel spill that occurred in 1978. The source of the spill was probably the overfilling of the diesel day tank located near the east wall of the hangar. The east side of the hangar area consists of gravel pad that slopes to the east to tundra.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 4.1.3.

4.1.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Diesel Spill site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

4.1.2.1 Summary of Samples Collected. A total of 18 samples was collected from the gravel pad, tundra, ponds, and drainage pathways at the site. These consisted of 14 soil, 2 sediment, and 2 surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Diesel Spill (SS05) site are presented in Figure 4-1.

Fourteen soil samples were analyzed for DRPH. In addition, 12 soil samples were analyzed for GRPH and BTEX. Two soil samples were analyzed for RRPH, and one soil sample was analyzed for VOCs.

Two sediment samples were analyzed for DRPH, GRPH, and BTEX.

Two surface water samples were analyzed for DRPH, GRPH, and BTEX. In addition, one sample was analyzed for VOCs, SVOCs, TDS, TSS, and TOC.

4.1.2.2 Analytical Results. The data summary table (Table 4-1) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 4-1. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil/sediment samples collected at the site include DRPH, GRPH, BTEX compounds, and five other VOCs. DRPH were detected 12 soil/sediment samples ranging from 5.65 to 17,300 mg/kg. GRPH were detected in eight soil/sediment samples at concentrations ranging from 0.888 to 422 mg/kg. BTEX (total) were detected in eight soil/sediment samples ranging from 0.149 to 11.57 mg/kg; xylenes were the primary component. Five other VOCs, all common components of diesel fuel, were detected in soil sample SS05-S01-1 at very low concentrations ranging from 0.051 to 0.501 mg/kg.

In surface water samples SS05-SW01 and SS05-SW02, DRPH were detected at concentrations of 425 and 403 µg/L, respectively. The DRPH were noted by the laboratory as being inconsistent with a middle distillate fuel and may be of biogenic origin. In addition, one other organic compound, 1,2-dichloroethane, was detected at 2.2 µg/L in surface water sample SS05-SW01 and at 1 µg/L in the associated field blank. 1,2-Dichloroethane is assumed to be a result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane.

Inorganics. Metals were not a concern at the site, and no metals analyses were performed. TOC, TSS, and TDS were reported at 17,300; 9,000; and 484,000 µg/L, respectively, in surface water sample SS05-SW01.

4.1.2.3 Summary of Site Contamination. The primary contaminants at the site are petroleum hydrocarbons (DRPH and GRPH) and VOCs (including BTEX) commonly associated with diesel fuels. The suspected source of contaminants detected during sampling conducted at the Diesel Spill is the 300-gallon fuel spill that occurred in 1978. No previous IRP sampling

is known to have been conducted at the site. The human health and ecological risks associated with chemicals detected at the site are presented in Section 4.1.4 and 4.1.5.

Based on field data, source of contamination, and concentration of contaminants, the contaminated area at the site is limited to approximately 6,667 square feet of tundra and approximately 1,422 square feet of gravel.

4.1.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

4.1.3.1 Topography and Stratigraphy. The site consists of a gravel pad placed on relatively flat tundra, upon which the hangar building has been constructed. The topography in the area is generally flat. The gravel pad, which is approximately three feet thick, provides the greatest topographic relief at the site. Several ponds are located in the tundra along the edge of the gravel pad. Drainage is to the southeast off of the gravel pad, and the adjacent tundra drains generally to the southwest.

The active layer at this site was approximately two feet thick in tundra areas and four feet thick under gravel pads and roads during the 1993 RI. Gravel pad material consisted of the typical gravels and sands associated with these features, and subsurface tundra materials were of the typical stratigraphy found at Oliktok Point (Section 2.4.4.2).

4.1.3.2 Migration Potential.

Subsurface Migration. The flat topography indicates that subsurface flow in the area would be sluggish, and analytical results indicate that petroleum compounds have migrated in a limited area in the subsurface. Due to the flat topography and limited extent of subsurface contaminants, the potential for migration of contaminants in the subsurface is considered low.

Surface Migration. The primary route of surface migration over the gravel portion of the site is overland sheet flow, and the primary route of surface migration over the tundra is through sluggish ephemeral streams. Significant surface migration is probably limited to spring thaw when large quantities of meltwater are available and the frozen ground prevents active layer water flow. However, the tundra ponds adjacent to the gravel pad are connected to a large shallow tundra lake located southwest of the site. Contaminants in the surface water at the site indicate that the potential for surface migration of contaminants is moderate to high.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Analytical data indicate that surface and subsurface soils have been affected in the immediate vicinity of the gravel pad. Although the potential for contaminant migration in active layer water exists, the surrounding topography indicates that flow in this area

should be relatively sluggish. Surface water analytical results indicate there is a potential for contaminant migration to occur in surface water.

4.1.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Diesel Spill (SS05) site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with, and incidental ingestion of, soil/sediment and ingestion of surface water. Because ground water and air at the Oliktok Point sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Oliktok Point Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site. The potential receptor groups evaluated include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Oliktok Point are presented in Section 4.1.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Oliktok Point Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be affected by the chemicals detected at the Oliktok Point installation. Because of the diversity of the plants and animals in the area of the Oliktok Point installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Tables 2-6 and 2-7.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Oliktok Point. The potential ecological risks associated with the chemicals at detected at the site are presented in Section 4.1.5.

4.1.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Diesel Spill (SS05) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to RBSLs and ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

4.1.4.1 Chemicals of Concern. DRPH and GRPH were identified as COCs for the soil matrix at the Diesel Spill site. The maximum concentrations of DRPH and GRPH exceeded their background concentrations and the ARAR concentrations for petroleum hydrocarbon contamination of soil (ADEC 1991).

DRPH were identified as a COC for the surface water at the Diesel Spill site. The maximum concentration of DRPH exceeded the background concentration and the RBSL based on noncancer hazard.

Table 4-2, Identification of COCs at the Diesel Spill, presents the maximum concentrations of chemicals detected at the site, the associated background concentrations, RBSLs, and ARARs, and the COCs selected in the risk evaluation.

4.1.4.2 Exposure Pathways and Potential Receptors. Because no COCs were identified for surface water at the site, only ingestion of soil/sediment was evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

4.1.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 0.3, and by a DEW Line worker is 0.01, based on the maximum concentrations of the COCs. The presence of DRPH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil or sediment at the site by a hypothetical native northern adult/child is 1×10^{-7}, and by a DEW Line worker is 6×10^{-9}, based on the maximum concentration of the carcinogenic COC. The presence of GRPH accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the site by a hypothetical native northerner or a DEW Line worker is 0.08, based on the maximum concentration of the COC. The presence of DRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

4.1.4.4 Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Diesel Spill site are limited to the low noncancer hazards (hazard indices of 0.3 and 0.01) and the very low cancer risk associated with GRPH. The noncancer hazards are below one and the cancer risk are below the threshold level of 1×10^{-6}. Both were calculated conservatively based on a potential future residential scenario. Therefore, the noncancer hazards and cancer risks associated with soil/sediment at the site are minimal.

A low hazard index of 0.08 is associated with the DRPH in surface water at the site, indicating a minimal noncancer risk. No carcinogenic COC was identified for the surface water at the Diesel Spill site. Remediation is not generally required at sites where the noncancer hazard does not exceed one. In addition, this potential risk was calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the chemicals in surface water do not currently pose a health hazard nor are they likely to pose a hazard in the future. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not known to be used as a water supply now, nor has it been used in the past.

In conclusion, under current or future uses the COCs identified soil/sediment at the Diesel Spill pose only minimal, if any, potential threat to human health. There was no COC selected for the surface water at the site based on noncancer hazard and cancer risk. Based on the human health risk assessment, remedial actions are not warranted at the site.

4.1.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the Oliktok Point installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

4.1.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. All sites at the installation were considered to be potentially usable habitat. It should be noted that the COC selection process only considered the soil/sediment samples that were at or less than 1.5 feet deep. The soil/sediment samples were screened for depth because it is unlikely that any of the representative species will be exposed to soils/sediments deeper than 1.5 feet. The COC identified in surface water at the site was DRPH. The COCs in soil/sediment at the Diesel Spill site were DRPH, ethylbenzene, and xylenes. None of the identified COCs were associated with significant ecological risk estimates under current conditions at the Diesel Spill site.

4.1.5.2 Summary of Ecological Risk Assessment. Based on the quantification of potential risks to ecological receptors and discussions presented in the Oliktok Point ERA, ecological risks at the Diesel Spill site are not significant.

4.1.6 Conclusions and Recommendations

Sampling and analyses have determined that the Diesel Spill (SS05) site is contaminated with petroleum compounds (DRPH and GRPH) and VOCs (including BTEX) commonly associated with diesel fuel. The contaminated media at the site include a small portion of the gravel pad east of the hangar and the adjacent tundra northeast of the hangar. The source of contamination is suspected to be spills and/or leaks associated with overfilling of the diesel day tank located near the east wall of the hangar. Analytical data indicate that there is a potential for contaminant migration.

The risk assessment concluded that risks posed to human health or ecological receptors by site contaminants are minimal given current or future site uses. The risks and hazards are based on a conservative future scenario and are not of a magnitude that normally requires remedial action.

Levels of DRPH, GRPH, and BTEX (total) detected in site soil/sediment, however, exceed ADEC guidance cleanup levels, and contaminants may be migrating in the surface water. Therefore, the site is being recommended for remedial action. The contaminated area at the site consists of approximately 237 cubic yards of gravel and 1,111 cubic yards of tundra. The remedial action alternative recommended for all media at the site is enhanced bioremediation. A complete description and evaluation of the remedial alternatives considered for this site are presented in the FS, Section 5.0.

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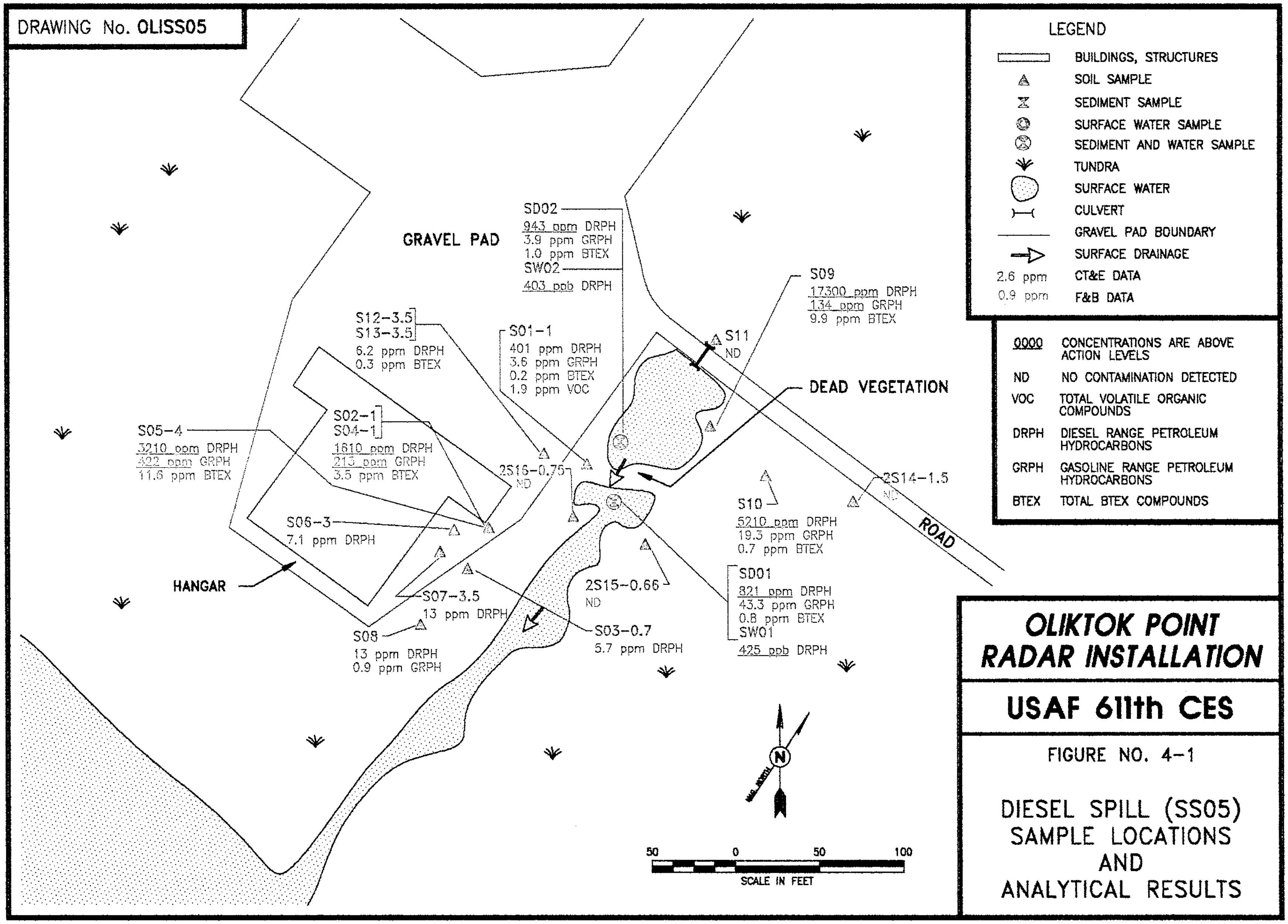

FIGURE NO. 4-1

DIESEL SPILL (SS05) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 4-1. DIESEL SPILL ANALYTICAL DATA SUMMARY

Installation: Oliktok Point
Site: Diesel Spill (SS05)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					S01-1	S02-1 & S04-1 (Replicates)		S03-0.7	S05-4	S06-3	AB01	EB01	TB01		
Laboratory Sample ID Numbers					4176-6 4280-12	4280-13	4280-15	4280-14	4218-4	4218-5	4209-7 4214-6	4172-1 4279-2 4174-2	4174-1 4279-1	4209 4214 4172 4174 4279	4280 4218 4176
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	13.8J[d]-167J[d]	401J[c]	1,610	1,260	5.65[d]	3,210	7.07[d]	NA	<200	NA	<200	<4.0
GRPH	0.400	0.400	100	<0.600-<1.00	3.60	213	175	<0.500	422	<0.400	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	0.231	3.534	1.572	<0.125	11.57	<0.100					
Benzene	0.020	0.020-1.50	0.5	<0.030-<0.060	<0.020	<0.020	<0.020	<0.025	<1.50	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-1.50		<0.030-<0.060	<0.020	<0.020	<0.020	<0.025	<1.50	<0.020	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-1.50		<0.030-<0.060	0.042	0.748	0.651	<0.025	2.35	<0.020	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-3.0		<0.060-<0.120	0.189	2.786	0.921	<0.050	9.22	<0.040	<2	<2	<2	<2	<0.040
VOC 8260															
n-Butylbenzene	0.020	0.025		<0.030-<0.045	0.079	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
p-Isopropyltoluene	0.020	0.025		<0.030-<0.045	0.057	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
Naphthalene	0.020	0.025		<0.030-<0.045	0.501	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
Toluene	0.020	0.025		<0.030-<0.045	0.051	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.025		<0.030-<0.045	0.486	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.025		<0.030-<0.045	0.232	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.050		<0.060-<0.090	0.482	NA	NA	NA	NA	NA	<2	<2	<2	<2	<0.040
SVOC 8270	0.020	0.230		<0.330-<3.30	<0.230	NA	NA	NA	NA	NA	NA	<10.1	NA	<10	<0.200

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that 34 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-1. DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Diesel Spill (SS05)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S07-3.5	S08	S09	S10	S11	AB01	EB02	TB02		
Laboratory Sample ID Numbers					4218-6	4218-7	4218-8	4218-9	4218-10	4214-6	4214-5 4209-6	4214-7	4214 4209	4218
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	13.8J[c]-167J[c]	13.0[c]	130[d]	17,300	5,210	<4.00	NA	NA	NA	NA	<4.00
GRPH	0.400	0.400	100	<0.600-<1.00	<0.400	0.888	134	19.3	<0.400	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.100	<0.200	9.90	0.652	<0.100					
Benzene	0.020	0.020-3.00	0.5	<0.030-<0.060	<0.020	<0.040	<3.00	<0.030	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-3.00		<0.030-<0.060	<0.020	<0.040	<3.00	<0.030	<0.020	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-3.00		<0.030-<0.060	<0.020	<0.040	<3.00	0.120	<0.020	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-6.00		<0.060-<0.120	<0.040	<0.080	9.90	0.532	<0.040	<2	<2	<2	<2	<0.040

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.
d The laboratory reported that 54 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-1. DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point   Matrix: Soil/Sediment
Site: Diesel Spill (SS05)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks				Lab Blanks	
					S12-3.5 & S13-3.5 (Replicates)		SD01	SD02	AB01	EB01	EB02	TB02		
Laboratory Sample ID Numbers					4218-11	4218-12	4280-10	4280-11	4214-6	4174-2	4209-6 4214-5	4214-7	4214 4174 4209	4280 4218
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	13.8J[f]-167J[f]	5.75[d]	6.23[e]	821	943	NA	<200	NA	NA	<100	<4.00
GRPH	0.400	0.400	100	<0.600-<1.00	<0.400	<0.400	43.3	3.90	NA	<20	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			15 Total BTEX	<0.150-<0.300	0.149	0.29	0.768	0.950						
Benzene	0.020	0.020-0.035	0.5	<0.030-<0.060	<0.020	<0.020	<0.035	<0.025	<1	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.035		<0.030-<0.060	0.113	0.29	<0.035	<0.025	<1	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.035		<0.030-<0.060	<0.020	<0.020	0.256	0.10	<1	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.070		<0.060-<0.120	0.036[c]	<0.040	0.512	0.850	<2	<2	<2	<2	<2	<0.040

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c Result is indicative of p & m xylenes only.
d The laboratory reported that 2.52 mg/kg of the EPH pattern in this sample was not consistent a with middle distillate fuel.
e The laboratory reported that 2.45 mg/kg of the EPH pattern in this sample was not consistent a with middle distillate fuel.
f The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-1. DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point Matrix: Soil
Site: Diesel Spill (SS05) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					2S14-1.5	2S15-0.66	2S16-0.75	AB02	2EB05	2TB05		
Laboratory Sample ID Numbers					1830	1832	1833	4263-4	1844	1848	#1&2-9793 4263	#5-9693 #1&2-9793
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	7-12	70-120	<500[a]	13.8J[d]-167J[d]	<80[b]	<120[b]	<60[b]	NA	NA	NA	NA	<50
GRPH	0.2	2	100	<0.600-<1.00	<2J[b]	NA	NA	NA	<50J[b]	<50J[b]	<50	<1
RRPH (Approx.)	14-24	140-240	2,000[a]	NA	<140	<240	<140	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.20	NA	NA					
Benzene	0.003	0.03	0.5	<0.030-<0.060	<0.03	NA	NA	<1[c]	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.030-<0.060	<0.02	NA	NA	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.005	0.05		<0.030-<0.060	<0.05	NA	NA	<1[c]	<2	<1	<1	<0.02
Xylenes (Total)	0.01	0.1		<0.060-<0.120	<0.1	NA	NA	<2[c]	<5	<2	<2	<0.04

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-1. DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point　　Matrix: Surface Water
Site: Diesel Spill (SS05)　　Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02				AB01	EB01	TB01	
Laboratory Sample ID Numbers					4172-5 4174-5 4279-7	4279-8				4209-7 4214-6	4172-1 4174-2 4279-2	4174-1 4279-1	4172/4174 4209/4214 4279
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L	µg/L	µg/L
DRPH	100	100		392[ad]-457J[ad]	425[ad]	403[ad]				NA	<200	NA	<200
GRPH	20	20		<20	<20	<20				NA	<20	NA	<20
BTEX (8020/8020 Mod.)													
Benzene	1	1	5	<1	<1	<1				<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	<1				<1	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	<1				<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	<2				<2	<2	<2	<2
VOC 8260													
1,2-Dichloroethane	1	1	5	<1	2.2B	NA				<1	1	<1	<1
SVOC 8270	10	10.8		<10	<10.8	NA				NA	<10.1	NA	<10
TOC	5,000	5,000		6,700-14,400	17,300	NA				NA	NA	NA	<5,000
TSS	100	200		6,000-9,000	9,000	NA				NA	NA	NA	<200
TDS	10,000	10,000		212,000-352,000	484,000	NA				NA	NA	NA	12,000

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE DIESEL SPILL (SS05)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Diesel Spill (SS05)	Soil	DRPH	17,300	mg/kg	13.8J-167J	--	--	500[c]	**Yes**
		GRPH	422	mg/kg	<0.600-<1.00	--	--	100[c]	**Yes**
		Toluene	0.29	mg/kg	<0.030-<0.060	--	5,400	--	No
		Ethylbenzene	2.35	mg/kg	<0.030-<0.060	--	2,700	--	No
		Xylenes (Total)	9.90	mg/kg	<0.060-<0.120	--	54,000	--	No
		n-Butylbenzene	0.079	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		p-Isopropyltoluene	0.057	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		Naphthalene	0.501	mg/kg	<0.030-<0.045	--	1,100	--	No
		1,2,4-Trimethylbenzene	0.486	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		1,3,5-Trimethylbenzene	0.232	mg/kg	<0.030-<0.045	--	--	--	**Yes***
	Surface Water	DRPH	425	µg/L	392-457J	--	292	--	**Yes**

* Chemicals without an RBSL or ARAR are considered chemicals of potential concern and are discussed in the Final Oliktok Point Risk Assessment, Section 2.1.5 (U.S. Air Force 1996).
NA Not analyzed.
a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.
J Result is an estimate.

4.2 Gasoline Storage Area (ST08)

4.2.1 Site Background

The Gasoline Storage Area consists of a gravel pad and tundra areas located to the north and east of the Garage (SS10). Two steel diesel storage tanks were formerly located north of the Garage on the west side of the gravel pad. Presently there is a gasoline storage tank on the gravel pad northeast of the Garage. The site is bordered on the north and east by tundra vegetation and ponds.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 4.2.3.

4.2.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Gasoline Storage Area site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

4.2.2.1 Summary of Samples Collected. A total of 29 samples was collected during the RI from the gravel pad, ponds, and adjacent tundra at the site. These consisted of 17 soil, 9 sediment, and 3 surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Gasoline Storage Area (ST08) site are presented in Figure 3-2.

Seventeen soil samples were analyzed for DRPH and RRPH. In addition, nine soil samples were analyzed for GRPH and BTEX. Six soil samples were analyzed for HVOCs and PCBs. Two samples were analyzed for VOCs and pesticides, and one sample was analyzed for SVOCs and total metals.

Nine sediment samples were analyzed for DRPH and RRPH. In addition, seven sediment samples were analyzed for GRPH, BTEX, HVOCs, and PCBs. One sediment sample was analyzed for VOCs, SVOCs, and total metals.

The three surface water samples were analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, and PCBs. In addition, one sample was analyzed for VOCs, SVOCs, total and dissolved metals, TOC, TSS, and TDS.

4.2.2.2 Analytical Results. The data summary table (Table 4-3) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 4-2. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or decontamination procedures. Only metals detected above background levels

that exceed an RBSL or ARAR are presented on Figure 3-2. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TOC, TSS, and TDS is included.

Organics. Organic compounds detected in soil/sediment samples collected at the site include DRPH, GRPH, RRPH, BTEX compounds, and seven other VOCs. DRPH were detected in 13 soil/sediment samples at concentrations ranging from 180 to 300,000 mg/kg. GRPH were detected in 10 samples at concentrations ranging from 23 to 2,200 mg/kg. RRPH were detected in sediment samples ST08-SD03; ST08-SD04; and ST08-SD05 at 450; 15,000; and 6,000 mg/kg, respectively. BTEX (total) were detected in nine soil/sediment samples at concentrations ranging from 0.76 to 89.5 mg/kg. Xylenes were the primary components; however, benzene was detected at up to 12.9 mg/kg. Seven other VOCs (sec-butylbenzene, isopropylbenzene, p-isopropyltoluene, naphthalene, n-propylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene) were detected in three soil/sediment samples at concentrations ranging from 0.096 to 27.4 mg/kg; the primary components were 1,2,4-trimethylbenzene (27.4 mg/kg) and 1,3,5-trimethylbenzene (24.7 mg/kg), which are both common components of diesel fuel.

One of the VOCs detected, n-propylbenzene (2.19 mg/kg), was also detected in the associated field blank at a similar concentration (sample 2EB05 at 1.6 mg/kg). The n-propylbenzene may be due to laboratory cross-contamination or field decontamination procedures and may not representative of actual site conditions.

One SVOC, bis(2-ethylhexyl)phthalate, was detected in surface water sample ST08-SW01 at a concentration of 48 µg/L; however, it is a common laboratory contaminant.

In surface water samples, organic compounds detected include two VOCs and one SVOC. The two VOCs detected, 1,2-dichloroethane and methylene chloride, were both detected at 1 mg/kg in surface water sample ST08-SW01. Methylene chloride was detected in the associated blanks at similar concentrations (in sample AB02 at 2.8 mg/kg and sample EB04 at 1.5 mg/kg), and 1,2-dichloroethane was detected in numerous field blank and background samples collected during the 1993 RI. Both VOCs are assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have included impurities including 1,2-dichloroethane and methylene chloride.

Inorganics. Metals analyses indicated that two metals (lead and manganese) were detected above background levels in soil/sediment samples. Lead and manganese were detected in sediment sample ST08-SD03 at 26 and 1,000 mg/kg respectively; manganese was also detected in soil sample ST08-S05-1 at 480 mg/kg.

In surface water samples, metals analyses indicated two metals (barium and iron) above background concentrations in surface water sample ST08-SW01 (220 and 3,100 µg/L, respectively). TOC, TSS, and TDS were reported at 32,300; 12,000; and 692,000 µg/L, respectively, in surface water sample ST08-SW01.

4.2.2.3 Summary of Site Contamination. The primary contaminants at the site are petroleum hydrocarbons (DRPH, GRPH, and RRPH) and VOCs (including BTEX) commonly associated with gasoline and diesel fuel. The suspected source of contaminants detected during sampling conducted at the Gasoline Storage Area site is spills and/or leaks associated with previous gasoline storage activities. The n-propylbenzene in soil and the 1,2-dichloroethane and methylene chloride detected in the surface water at the site are probably false positives due to laboratory or field cross contamination. Metals detected in soil/sediment and surface water at the site were evaluated in the risk assessment, and site concentrations were determined not to be significant. No previous IRP sampling is known to have been conducted at the site. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 4.2.4 and 4.2.5. Based on field data, source of contamination, and concentrations of contaminants, the area of affected soil at this site includes 17,778 square feet of tundra located north and west of the gravel pad. The affected gravel at the site is being combined with the gravel at the adjacent Garage (SS10) site in the FS.

4.2.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

4.2.3.1 Topography and Stratigraphy. The site consists of two approximately four-feet-thick gravel pads placed on relatively flat tundra. The gravel pads are connected west of the site by a gravel road of the same elevation. The Garage (SS10) site is southwest, adjacent to the site. The topography at the site is relatively flat with the gravel pad providing the greatest topographic relief. Drainage in the vicinity is generally to the east through a series of sluggish ephemeral streams.

During the 1993 RI, permafrost was located at a depth of up to four feet under the gravel pads and at a depth of two feet under tundra areas. Gravel pads consisted of the typical gravels and sands associated with these structures, and subsurface tundra materials were of the typical stratigraphy found at Oliktok Point (Section 2.4.4.2).

4.2.3.2 Migration Potential.

Subsurface Migration. Analytical data indicate that the subsurface at the site has been affected by petroleum hydrocarbons (DRPH, GRPH, RRPH) and associated VOCs (including BTEX). The primary area affected is the northwest corner of the gravel pad and the tundra adjacent to the gravel pad to the north and west. Contaminants detected in gravel pad should migrate radially out to the tundra. Subsurface migration in the tundra will tend to be very sluggish due to the fine sedimentary material, the flat topography, and the underlying permafrost. Site topography indicates that subsurface flow in this area, although sluggish, should be radial away from the gravel pad. Based upon this, the potential for subsurface contaminant migration is considered to be low.

Surface Migration. The primary route of surface migration over the gravel pad at the site is overland sheet flow. Significant surface migration over the gravel pad area is probably restricted to the spring thaw when large quantities of meltwater are available and the frozen ground prevents active layer flow. Surface migration on the gravel pad will follow surface contours, which are generally radial from the gravel pad out to the tundra, and surface water bodies that border the site.

The surface water generally drains to the west through a series of ephemeral streams. Analytical data indicate that surface migration has occurred in the tundra at this site. Petroleum compounds and associated VOCs were detected in sediment/soil samples in the drainage pathways associated with site. Contaminant concentrations decrease with distance from the drainage pathways.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Analytical results indicate that contaminant migration is occurring in the surface and subsurface at the site. The topography indicates that any affected active layer water will be sluggish but will generally migrate north and west out from the gravel pad at the site into the tundra. Significant surface migration occurs primarily in spring when large quantities of meltwater are available.

4.2.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Gasoline Storage Area site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, incidental ingestion of soil/sediment, and ingestion of surface water. Because ground water and air at the Oliktok Point sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Oliktok Point Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with chemicals at Oliktok Point are presented in Section 4.2.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Oliktok Point Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Oliktok Point installation. Because of the diversity of the plants and animals in the area of the Oliktok Point installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic

invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Tables 2-6 and 2-7.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Oliktok Point. The potential ecological risks associated with the chemicals detected at the site are presented in Section 4.2.5.

4.2.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Gasoline Storage Area (ST08) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

4.2.4.1 Chemicals of Concern. DRPH, GRPH, RRPH, and benzene were identified as COCs for the soil matrix at the Gasoline Storage Area. DRPH and GRPH exceeded the background concentration and the ARAR concentration for petroleum hydrocarbon contamination of soil. A background concentration was not available for RRPH; however, this mixture exceeded the ARAR concentration for petroleum hydrocarbon contamination of soil (ADEC 1991). Benzene exceeded the background concentration, the RBSL based on cancer risk, and the ARAR based on ADEC (1991).

1,2-Dichloroethane and bis(2-ethylhexyl)phthalate were identified as COCs for surface water at the Gasoline Storage Area. The maximum concentration of 1,2-dichloroethane exceeded the background concentration and the RBSL based on cancer risk, but not the ARAR, which is a maximum contaminant level (MCL) promulgated under the federal Safe Drinking Water Act. Bis(2-ethylhexyl)phthalate exceeded the background concentration, the RBSL based on cancer risk, and the ARAR, which is an MCL promulgated under the federal Safe Drinking Water Act. Bis(2-ethylhexyl)phthalate did not exceed the RBSL based on noncancer hazard.

Table 4-4, Identification of COCs at the Gasoline Storage Area, presents the maximum concentrations of chemicals detected at the site, the associated background concentrations, RBSLs, and ARARs, and identifies COCs selected in the risk evaluation.

4.2.4.2 Exposure Pathways and Potential Receptors. Because COCs were identified for soil/sediment and surface water at the site, the potential risks associated with ingestion of soil/sediment and surface water were evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

4.2.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Gasoline Storage Area by a hypothetical native northern adult/child is 5, and by a DEW Line worker is 0.2, based on the maximum concentrations of the COCs. The presence of DRPH, GRPH, and RRPH and accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations. DRPH account for more than 99 percent of the noncancer hazard.

The excess lifetime cancer risk associated with the ingestion of soil/sediment at this site by a hypothetical native northern adult/child is 7×10^{-7}, and by a DEW Line worker is 3×10^{-8}, based on the maximum concentrations of the COCs. The presence of GRPH and benzene accounts entirely for the quantifiable cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the Gasoline Storage Area by a hypothetical native northern adult or a DEW Line worker is 0.03 based on the maximum concentration of the COC. The presence of bis(2-ethylhexyl)phthalate accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 8×10^{-6}, and by a DEW Line worker is 2×10^{-6}, based on the maximum concentration of the COCs. The presence of 1,2-dichloroethane and bis(2-ethylhexyl)phthalate accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

4.2.4.4 Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Gasoline Storage Area site are the noncancer hazard (hazard indices of 5 and 0.2) and low cancer risk associated with GRPH and benzene. Although the estimated hazard index of five exceeds one, it was calculated based on several conservative assumptions. It is based primarily on the maximum concentration of DRPH detected in one sediment sample and assumes this concentration is homogeneously distributed throughout the site. It assumes the exposure concentration will remain constant over the calculated exposure period of 55 years. In addition, these risks and hazards were calculated conservatively based on ingestion of soil at a rate associated with a potential future residential scenario. It is very unlikely that the soil at this location would be ingested at the conservative rate used in the risk calculation, and the hazards and risks at the site are likely to be overestimated. Therefore on

the basis of the human health risk assessment, remediation of the site is not necessarily warranted.

A hazard index of 0.03 is associated with bis(2-ethylhexyl)phthalate in surface water at the site indicating a minimal noncancer risk. The cancer risk in surface water for the native adult is 8×10^{-6}, and for a DEW Line worker is 2×10^{-6}. These hazards and risks were calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the chemicals in surface water do not currently pose a health hazard nor are they likely to pose a hazard in the future. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not known to be used as a water supply now, nor has it been used in the past. In addition, remedial action is generally not warranted at sites where the excess lifetime cancer risk is less than 1×10^{-4} and the noncancer hazards do not exceed one (EPA 1991b), and on the basis of the risk assessment, remediation of the site is not necessarily warranted.

In conclusion, under current uses the COCs identified in surface water at the Gasoline Storage Area site pose only a minimal, if any, potential threat to human health. The noncancer hazards associated with the maximum concentration of DRPH detected in one sediment sample at the site are based on several conservative assumptions and are likely to be overestimated. Therefore, based on the human health risk assessment, remedial actions are not necessarily warranted at the site.

4.2.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the Oliktok Point installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

4.2.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. All sites at the installation were considered as potentially usable habitat. It should be noted that the COC selection process only considered the soil/sediment samples that were at or less than 1.5 feet deep. The soil/sediment samples were screened for depth because it is unlikely that any of the representative species will be exposed to soil/sediments deeper than 1.5 feet. No COCs were identified in surface water at the site. The COCs in soil/sediment samples at the Gasoline Storage Area site were DRPH, benzene, toluene, ethylbenzene, xylenes, and manganese. None of the identified COCs were associated with significant ecological risk estimates under current conditions at the Gasoline Storage Area site.

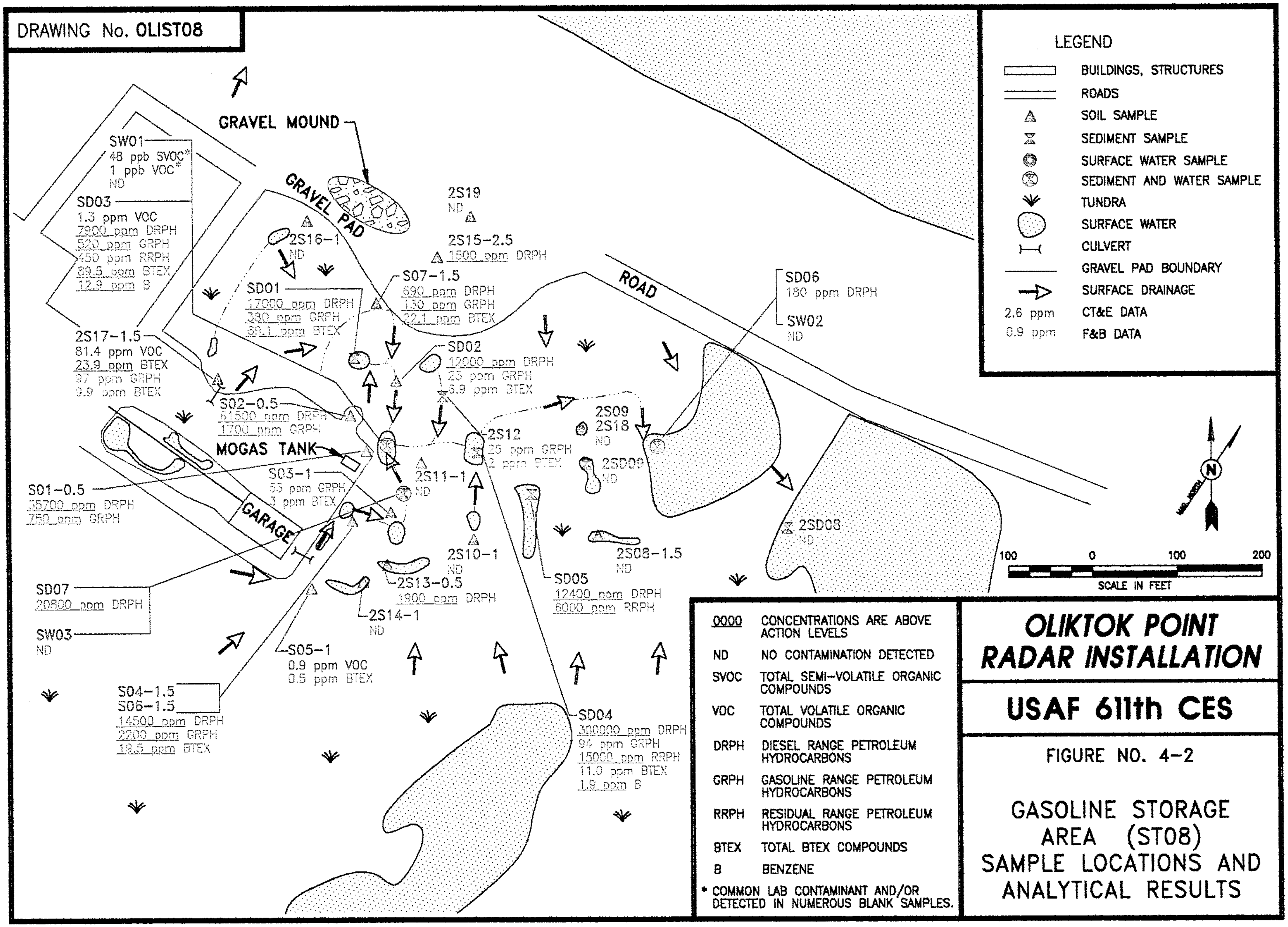
4.2.5.2 Summary of Ecological Risk Assessment. Based on the quantification of potential risks to ecological receptors and discussions presented in the Oliktok Point ERA, ecological risks under current conditions at the Gasoline Storage Area site are not significant.

4.2.6 Conclusions and Recommendations

Sampling and analyses have determined that the Gasoline Storage Area (ST08) site is contaminated with petroleum hydrocarbons (DRPH, GRPH, and RRPH) and VOCs (including BTEX) that are components of diesel fuel. The significantly contaminated area at the site includes approximately 2,963 cubic yards of tundra located north and west of the gravel pad adjacent to the Garage (SS10) site. Significantly contaminated gravel at the Gasoline Storage Area has been combined with the contaminated gravel at the adjacent Garage site for the purposes of remediation and is discussed in Section 4.3 and in the FS, Section 5.0. Contaminants appear to have migrated primarily in the surface water. Analytical results indicate the highest petroleum concentrations were in the drainage pathways leading from the site. The suspected source of contamination is previous spills and/or leaks associated with previous gasoline storage activities conducted at the site.

The risk assessment concluded that risks posed to human health and ecological receptors are minimal given current site uses. The human health risk is not of a magnitude that normally requires remedial action. The ERA concluded that the overall potential risks presented by site contaminants are minimal.

Levels of petroleum compounds (DRPH, GRPH, RRPH, and BTEX) detected at the site, however, significantly exceed ADEC guidance cleanup levels and migration of contaminants has occurred. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is recommended. The remedial action alternative recommended for the tundra at the site is enhanced bioremediation. A complete description and evaluation of the remedial alternatives recommended for this site are presented in the FS, Section 5.0.



DRAWING No. OLIST08
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLE
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
GRAVEL MOUND
GRAVEL PAD
ROAD
MOGAS TANK
GARAGE
SW01 48 ppb SVOC* 1 ppb VOC* ND
SD03 1.3 ppm VOC 7900 ppm DRPH 520 ppm GRPH 450 ppm RRPH 89.5 ppm BTEX 12.9 ppm B
2S17-1.5 81.4 ppm VOC 23.9 ppm BTEX 97 ppm GRPH 9.9 ppm BTEX
2S16-1 ND
SD01 17000 ppm DRPH 380 ppm GRPH 58.1 ppm BTEX
2S19 ND
2S15-2.5 1500 ppm DRPH
S07-1.5 690 ppm DRPH 130 ppm GRPH 22.1 ppm BTEX
SD02 12000 ppm DRPH 25 ppm GRPH 5.9 ppm BTEX
S02-0.5 61500 ppm DRPH 1700 ppm GRPH
S03-1 55 ppm GRPH 3 ppm BTEX
S01-0.5 35700 ppm DRPH 750 ppm GRPH
2S11-1 ND
2S12 25 ppm GRPH 2 ppm BTEX
2S09 2S18 ND
2SD09 ND
SD06 180 ppm DRPH
SW02 ND
2SD08 ND
2S10-1 ND
2S13-0.5 1900 ppm DRPH
2S14-1 ND
SD05 12400 ppm DRPH 8000 ppm RRPH
2S08-1.5 ND
SD07 20800 ppm DRPH
SW03 ND
S05-1 0.9 ppm VOC 0.5 ppm BTEX
S04-1.5 S06-1.5 14500 ppm DRPH 2200 ppm GRPH 18.5 ppm BTEX
SD04 300000 ppm DRPH 94 ppm GRPH 15000 ppm RRPH 11.0 ppm BTEX 1.9 ppm B
N
100 0 100 200
SCALE IN FEET
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
SVOC TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
B BENZENE
* COMMON LAB CONTAMINANT AND/OR DETECTED IN NUMEROUS BLANK SAMPLES.
OLIKTOK POINT RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 4-2
GASOLINE STORAGE AREA (ST08) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					S01-0.5	S02-0.5	S03-1	S04-1.5 & S06-1.5 (Replicates)		S05-1	AB02	EB04	TB04		
Laboratory Sample ID Numbers					294	296	298	300	264	261 4264-2	4263-4	254/257 4263-6	252 4263-5	#5-82193 #1&2-82193 4263	#5-82193 #1&2-82193 4264
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	7-8	70-80	500[a]	13.8J[d]-167J[d]	35,700J[b]	61,500J[b]	<70[b]	14,500J[b]	12,000[b]	<80[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.1-5.3	1-53	100	<0.600-<1.00	750J[b]	1,700J[b]	<53J[b]	2,200J[b]	1,100J[b]	<1J[b]	NA	<50J[b]	<1J[b]	<50	<1
RRPH (Approx.)	10	100	2,000[a]	NA	<100	<100	<100	<100	<100	<100	NA	<100	NA	<1,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<72	<97	<4.03	<70	19.5J	0.49J					
Benzene	0.002-2.0	0.02-20	0.5	<0.030-<0.060	<9	<20	<0.03	<9	0.03J	0.06J	<1[c]	<1	<1	<1	<0.02
Toluene	0.002-2.7	0.02-27		<0.030-<0.060	<12	<27	<0.8	<8	2.4	0.09	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.002-1.6	0.02-16		<0.030-<0.060	<7	<13	<1.1	<16	7.1	0.21	<1[c]	<1	<1	<1	<0.02
Xylenes (Total)	0.004-4.4	0.04-44		<0.060-<0.120	<44	<37	<2.1	<37	10J	0.13J	<2[c]	<2	<2	<2	<0.04
HVOC 8010	0.002-0.003	0.02-0.03		NA	<0.03	<0.03	<0.03	<0.02	<0.02	<0.02	NA	<1	<1	<1	<0.02
VOC 8260															
Benzene	0.020	0.045	0.5	<0.030-<0.045	NA	NA	NA	NA	NA	0.047	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.045		<0.030-<0.045	NA	NA	NA	NA	NA	0.158	<1	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.045		<0.030-<0.045	NA	NA	NA	NA	NA	0.096	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.020	0.045		<0.060-<0.090	NA	NA	NA	NA	NA	0.556	<2	<2	<2	<2	<0.040
SVOC 8270	0.200	3.50		<0.330-<3.30	NA	NA	NA	NA	NA	<3.50J	NA	<22	NA	<10	<0.200

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					S01-0.5	S02-0.5	S03-1	S04-1.5 & S06-1.5 (Replicates)		S05-1	AB02	EB04	TB04		
Laboratory Sample ID Numbers					294	296	298	300	264	261 4264-2	4263-4	254/257 4263-6	252 4263-5	#5-82193 #1&2-82193 4263	#5-82193 #1&2-82193 4264
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
Pesticides	0.001-0.05	0.01-0.5		<0.005-<0.100	<0.01J-<0.5J	NA	NA	NA	NA	<0.02J-<0.5J	NA	<0.2J-<10J	NA	NA	<0.01J-<0.5J
PCBs	0.01	0.1	10	<0.030-<0.100	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<2	NA	<2	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					S07-1.5	SD01	SD02	SD03	SD04	SD05	AB02	EB04	TB04		
Laboratory Sample ID Numbers					280	238	240	242 4264-1	244	246	4263-4	254/257 4263-6	252 4263-5	#5-82193 #1&2-82193 4263	#6-82193 #5-82193 #1&2-82193 4264
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	13.8J[d]-167J[d]	690[b]	17,000J[b]	12,000J[b]	7,900J[b]	300,000J[b]	12,400J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.1-1.4	1-14	100	<0.600-<1.00	130J[b]	380J[b]	23J[b]	520J[b]	94J[b]	<14J[b]	NA	<50J[b]	<1J[b]	<50	<1
RRPH (Approx.)	10-20	100-200	2,000[a]	NA	<200	<100	<100	450	15,000	8,000	NA	<100	NA	<1,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	22.05J	69.1J	6.85J	89.5J	10.88J	<3.18					
Benzene	0.002	0.02	0.5	<0.030-<0.060	0.05J	4.2J	0.05J	12.9J	1.8J	<0.02	<1[c]	<1	<1	<1	<0.02
Toluene	0.002-0.016	0.02-0.16		<0.030-<0.060	1.6	4.2	0.3	15.8	1.5	<0.16	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.12	0.021.2		<0.030-<0.060	3.4	23.7	2.7	34	0.58	<1.2	<1[c]	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.018	0.04-1.8		<0.060-<0.120	17J	37J	3.8J	26.8J	7J	<1.8	<2[c]	<2	<2	<2	<0.04
HVOC 8010	0.002-0.02	0.02-0.2		NA	<0.04	<0.03	<0.02	<0.05	<0.02	<0.2	NA	<1	<1	<1	<0.02
VOC 8260															
1,2,4-Trimethylbenzene	0.020	0.200		<0.030-<0.045	NA	NA	NA	0.245	NA	NA	<1	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.200		<0.030-<0.045	NA	NA	NA	0.507	NA	NA	1	1	1	<1	<0.020
Xylenes (Total)	0.020	0.200		<0.060-<0.090	NA	NA	NA	0.581	NA	NA	<2	<2	<2	<2	<0.040
SVOC 8270	0.200	3.00		<0.330-<3.30	NA	NA	NA	<3.00J	NA	NA	NA	<22	NA	<10	<0.200
PCBs	0.01-0.02	0.1-0.2	10	<0.030-<0.100	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1	NA	<2	NA	<2	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point Matrix: Soil/Sediment METALS ANALYSES
Site: Gasoline Storage Area (ST08) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank	Lab Blanks
					S05-1	SD03					EB04	
Laboratory Sample ID Numbers					4264-2	4264-1					4263-6	4264 4263
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	3,600	2,700					<100	<100
Antimony	N/A	78-90		<7.8-<230	<90	<78					<100	<100
Arsenic	0.11	7.8-9.0		<4-8.5	<9.0	<7.8					<100	<100
Barium	0.024	1		27-390	130	220					<50	<50
Beryllium	N/A	3.9-4.5		<2.6-6.4	<4.5	<3.9					<50	<50
Cadmium	0.33	3.9-4.5		<3.0-<36	<4.5	<3.9					<50	<50
Calcium	0.69	4		360-59,000	7,800	17,000					<200	<200
Chromium	0.066	1		<4.3-47	7.2	8.3J					<50	<50
Cobalt	N/A	7.8-9.0		<5.1-12	<9.0	<7.8					<100	<100
Copper	0.045	1		<2.7-45	12	17					<50	<50
Iron	0.50	2		5,400-35,000	17,000	20,000					<100	<100
Lead	0.13	2-9.0		<5.1-22	<9.0	26					<100	<100
Magnesium	0.96	4		360-7,400	1,500	2,100					<200	<200
Manganese	0.025	1		25-290	480	1,000					<50	<50
Molybdenum	N/A	3.9-4.5		<2.5-<11	<4.5	<3.9					<50	<50
Nickel	0.11	1		4.2-46	11	9.0					<50	<50

□ CT&E Data.
N/A Not analyzed.
J Result is an estimate.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)
Matrix: Soil/Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank	Lab Blanks
					S05-1	SD03					EB04	
Laboratory Sample ID Numbers					4264-2	4264-1					4263-6	4264 4263
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Potassium	23	390-450		<300-2,200	<450	<390					<5,000	<5,000
Selenium	1.2	78-90		<7.8-<170	<90	<78					<100	<100
Silver	0.53	3.9-4.5		<3-<110	<4.5	<3.9					<50	<50
Sodium	0.55	5		<160-680	540	260					<250	<250
Thallium	0.011	0.34-0.44		<0.2-<1.2	<0.44	<0.34					<5	<5
Vanadium	0.036	1		6.3-59	11	11					<50	<50
Zinc	0.16	1		9.2-95	28	36					<50	<50

☐ CT&E Data.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point   Matrix: Sediment
Site: Gasoline Storage Area (ST08)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks	
					SD06	SD07	AB02	EB04	TB04		
Laboratory Sample ID Numbers					248	250	4263-4	254/257	252	#5-82193 #1&2-82193 4263	#6-82193 #1&2-82193
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	13.8J[d]-167J[d]	180J[b]	20,800J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	1-17	10-170	100	<0.600-<1.00	<10J[b]	<170J[b]	NA	<50J[b]	<1J[b]	<50	<1
RRPH (Approx.)	10	100	2,000[a]	NA	<100	<100	NA	<100	NA	<1,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<8.3	<0.76					
Benzene	0.002-0.12	0.02-1.2	0.5	<0.030-<0.060	<1.2	<0.02	<1[c]	<1	<1	<1	<0.02
Toluene	0.008-0.09	0.08-0.9		<0.030-<0.060	<0.9	<0.08	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.015-0.23	0.15-2.3		<0.030-<0.060	<2.3	<0.15	<1[c]	<1	<1	<1	<0.02
Xylenes (Total)	0.051-0.39	0.51-3.9		<0.060-<0.120	<3.9	<0.51	<2[c]	<2	<2	<2	<0.04
HVOC 8010	0.002-0.005	0.02-0.05		NA	<0.05	<0.02	NA	<1	NA	<1	<0.02
PCBs	0.02-0.06	0.2-0.6	10	<0.030-<0.100	<0.2	<0.6	NA	<2	NA	<2	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point   Matrix: Soil
Site: Gasoline Storage Area (ST08)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					2S08-1.5	2S09 & 2S18 (Replicates)		2S10-1	2S11-1	2S12	AB02	2EB05	2TB05		
Laboratory Sample ID Numbers					1816	1818	1829	1819	1820	1822	4263-4	1844	1845	#1&2-9793 4263	#5-9693 #1&2-9793
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-12	60-120	500[a]	13.8J[d]-167J[d]	<110[b]	<60[b]	<120[b]	<70[b]	<100[b]	<80[b]	NA	NA	NA	NA	<50
GRPH	0.2	2	100	<0.600-<1.00	<2J[b]	NA	NA	NA	NA	25J[b]	NA	<50J[b]	<50J[b]	<50	<1
RRPH (Approx.)	14-24	140-240	2,000[a]	NA	<240	<160	<240	<140	<200	<160	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.16	NA	NA	NA	NA	2J					
Benzene	0.003-0.004	0.03-0.04	0.5	<0.030-<0.060	<0.04	NA	NA	NA	NA	<0.03	<1[c]	<1	<1	<1	<0.02
Toluene	0.003-0.004	0.03-0.04		<0.030-<0.060	<0.04	NA	NA	NA	NA	<0.03	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.003-0.006	0.03-0.06		<0.030-<0.060	<0.06	NA	NA	NA	NA	1	<1[c]	<2	<1	<1	<0.02-<0.03
Xylenes (Total)	0.006-0.02	0.06-0.2		<0.060-<0.120	<0.2	NA	NA	NA	NA	1J	<2[c]	<5	<2	<2	<0.04-<0.09

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					2S13-0.5	2S14-1	2S15-2.5	2S16-1	2S17-1.5	2S19-2.5	AB02	2EB05	2TB05		
Laboratory Sample ID Numbers					1823	1824	1825	1826	1827 1828 4628-11	1834	4263-4	1844 4628-6	1845 4628-5	#1&2-9793 4263	#5-9693 #1&2-9793 4628
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-11	60-110	500[a]	13.8J[d]-167J[d]	1,800J[b]	<80[b]	1,500J[b]	<110[b]	<70[b]	<60[b]	NA	NA	NA	NA	<50
GRPH	0.2	2	100	<0.600-<1.00	NA	NA	NA	NA	97J[b]	NA	NA	<50J[b]	<50J[b]	<50	<1
RRPH (Approx.)	12-24	120-240	2,000[a]	NA	<160	<160	<120	<240	<140	<140	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	NA	NA	NA	NA	9.8J	NA					
Benzene	0.02	0.2	0.5	<0.030-<0.060	NA	NA	NA	NA	0.2J	NA	<1[c]	<1	<1	<1	<0.02
Toluene	0.02	0.2		<0.030-<0.060	NA	NA	NA	NA	0.7	NA	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.02	0.2		<0.030-<0.060	NA	NA	NA	NA	0.7	NA	<1[c]	<2	<1	<1	<0.02-<0.03
Xylenes (Total)	0.04	0.4		<0.060-<0.120	NA	NA	NA	NA	8.3J	NA	<2[c]	<5	<2	<2	<0.04-<0.09
VOC 8260															
sec-Butylbenzene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	0.346	NA	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	0.793	NA	<1	<1	<1	<1	<0.020
Isopropylbenzene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	0.525	NA	<1	<1	<1	<1	<0.020
p-Isopropyltoluene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	0.273	NA	<1	<1	<1	<1	<0.020
Naphthalene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	1.99	NA	<1	<1	<1	<1	<0.020
n-Propylbenzene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	2.19B	NA	<1	1.6	<1	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					2S13-0.5	2S14-1	2S15-2.5	2S16-1	2S17-1.5	2S19-2.5	AB02	2EB05	2TB05		
Laboratory Sample ID Numbers					1823	1824	1825	1826	1827 1828 4628-11	1834	4263-4	1844 4628-6	1845 4628-5	4628 4263	4628
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
Toluene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	0.940	NA	<1	1.6	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	27.4	NA	<1	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.200		<0.030-<0.045	NA	NA	NA	NA	24.7	NA	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.400		<0.060-<0.090	NA	NA	NA	NA	22.2	NA	<2	<2	<2	<2	<0.040

□ CT&E Data.
NA Not analyzed.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point — Matrix: Sediment
Site: Gasoline Storage Area (ST08) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blank	Lab Blanks	
					2SD08	2SD09				EB04		
Laboratory Sample ID Numbers					1814	1815				254	#5-82193	#5-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L	mg/kg
DRPH	20	200	500[a]	13.8J[d]-167J[d]	<200[b]	<200[b]				<1,000[b]	<1,000	<50
RRPH (Approx.)	40	400	2,000[a]	<0.600-<1.00	<400	<400				<1,000	<1,000	<100

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks
					SW01	SW02	SW03	AB02	EB04	TB04	
Laboratory Sample ID Numbers					218/228 4263-1	230/233	234/237	4263-4	254/257 4263-6	252 4263-5	#5-82193 #1&2-82193 4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		392[ad]-457J[ad]	<1,000J[b]	<1,000[b]	<1,000[b]	NA	<1,000[b]	NA	<1,000
GRPH	5	50		<20	<50J[b]	<50J[b]	<50J[b]	NA	<50J[b]	<1J[b]	<50
RRPH (Approx.)	100	1,000		NA	<1,000	<1,000	<1,000	NA	<1,000	NA	<1,000
BTEX (8020/8020 Mod.)											
Benzene	01	1	5	<1	<1	<1	<1	1[c]	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	<1	1[c]	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	<1	1[c]	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	<2	2[c]	<2	<2	<2
HVOC 8010	0.1	1		NA	<1	<1	<1	NA	<1	<1	<1
VOC 8260											
1,2-Dichloroethane	1	1	5	<1	1	NA	NA	<1	<1	<1	<1
Methylene chloride	1	1	5	<1	1B	NA	NA	2.8	1.5	<1	<1

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks
					SW01	SW02	SW03	AB02	EB04	TB04	
Laboratory Sample ID Numbers					218/228 4263-1	230/233	234/237	4263-4	254/257 4263-6	252 4263-5	4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
SVOC 8270											
bis (2-Ethylhexyl) phthalate	10	22	6	<10	48	NA	NA	NA	<22	NA	<10
PCBs	0.2	2	0.5	<1-<2	<2	<2	<2	NA	<2	NA	<2
TOC	5,000	5,000		6,700-14,400	32,300	NA	NA	NA	NA	NA	<5,000
TSS	100	200		6,000-9,000	12,000	NA	NA	NA	NA	NA	<200
TDS	10,000	10,000		212,000-352,000	692,000	NA	NA	NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blank
					SW01					EB04	
Laboratory Sample ID Numbers					4263-1					4263-6	4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)					<100	<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)					<100	<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)					<100	<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	220 (210)					<50	<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)					<50	<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)					<50	<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	82,000 (83,000)					<200	<200-378 (378)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)					<50	<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)					<100	<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)					<50	<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	3,100 (630)					<100	<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blank
					SW01					EB04	
Laboratory Sample ID Numbers					4263-1					4263-6	4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Lead	6.6	100	15	<100 (<100)	<100 (<100)					<100	<100 (<100)
Magnesium	47.8	50		<5,000-53,000 (2,600-54,000)	29,000 (31,000)					<200	<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	290 (280)					<50	<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)					<50	<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)					<50	<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)					<5,000	<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)					<100	<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)					<50	<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	120,000 (120,000)					<250	<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)					<5	<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)					<50	<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 4-3. GASOLINE STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Gasoline Storage Area (ST08)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blank
					SW01					EB04	
Laboratory Sample ID Numbers					4263-1					4263-6	4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Zinc	8.2	50		<50-160 (<50)	<50 (<50)					<50	<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 4-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE GASOLINE STORAGE AREA (ST08)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Gasoline Storage Area (ST08)	Soil	DRPH	300,000J	mg/kg	13.8J-167J	--	--	500[c]	**Yes**
		GRPH	2,200J	mg/kg	<0.600-<1.00	--	--	100[c]	**Yes**
		RRPH	15,000	mg/kg	NA	--	--	2,000[c]	**Yes**
		Benzene	12.9J	mg/kg	<0.030-<0.060	2.2	--	0.5[c]	**Yes**
		Toluene	15.8	mg/kg	<0.030-<0.060	--	5,400	--	No
		Ethylbenzene	34	mg/kg	<0.030-<0.060	--	2,700	--	No
		Xylenes (Total)	37J	mg/kg	<0.060-<0.120	--	54,000	--	No
		sec-Butylbenzene	0.346	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		Isopropylbenzene	0.525	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		p-Isopropyltoluene	0.273	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		Naphthalene	1.99	mg/kg	<0.030-<0.045	--	1,100	--	No
		1,2,4-Trimethylbenzene	27.4	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		1,3,5-Trimethylbenzene	24.7	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		Aluminum	3,600	mg/kg	1,500-25,000	--	--	--	No
		Barium	220	mg/kg	27-390	--	1,890	--	No
		Calcium	17,000	mg/kg	360-59,000	--	--	--	No
		Chromium	8.3J	mg/kg	<4.3-47	--	135	--	No
		Copper	17	mg/kg	<2.7-45	--	999	--	No
		Iron	20,000	mg/kg	5,400-35,000	--	--	--	No
		Lead	26	mg/kg	<5.1-22	--	--	500[d]	No
		Magnesium	2,100	mg/kg	360-7,400	--	--	--	No
		Manganese	1,000	mg/kg	25-290	--	3,780	--	No
		Nickel	11	mg/kg	4.2-46	--	540	--	No
		Sodium	540	mg/kg	<160-680	--	--	--	No
		Vanadium	11	mg/kg	6.3-59	--	189	--	No

TABLE 4-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE GASOLINE STORAGE AREA (ST08) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Gasoline Storage Area	Soil	Zinc	36	mg/kg	9.2-95	--	8,100	--	No
(ST08)	Surface Water[h]	1,2-Dichloroethane	1	µg/L	<1	0.934	--	5[e]	**Yes**
(Continued)		bis (2-Ethylhexyl) Phthalate	48	µg/L	<10	6.07	73.0	6[f]	**Yes**
		Barium	220	µg/L	<50-93	--	256	2,000[g]	No
		Calcium	82,000	µg/L	4,500-88,000	--	--	--	No
		Iron	3,100	µg/L	180-2,800	--	--	--	No
		Magnesium	29,000	µg/L	<5,000-53,000	--	--	--	No
		Manganese	290	µg/L	<50-510	--	18.3	--	No
		Sodium	120,000	µg/L	8,400-410,000	--	--	--	No

* Chemicals without an RBSL or ARAR are considered chemicals of potential concern and are discussed in the Final Oliktok Point Risk Assessment, Section 2.1.5 (U.S. Air Force 1996).
NA Not analyzed.
a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.
d EPA 1991c.
e MCL, 52 FR 25690 (08 July 1987).
f MCL, 57 FR 31776 (17 July 1992).
g MCL, 56 FR 30266 (01 January 1991).
h The concentrations reported for metals in surface water are total metals.
J Result is an estimate.

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4.3 Garage (SS10)

4.3.1 Site Background

The Garage site is located approximately 200 feet east of the module train. The Garage is an approximately 90-foot by 40-foot building elevated about four feet above the tundra and is surrounded on the north, east, and south sites by gravel pad. The building is used for vehicle maintenance and storage. The floor drains in this building previously discharged to pathways leading directly to the tundra. The drains were sealed by the Air Force in July 1993 to prevent future release of contaminants from the Garage to the tundra.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 4.3.3.

4.3.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Garage (SS10) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

4.3.2.1 Summary of Samples Collected. A total of 15 samples was collected at the site. These consisted of 13 soil samples, 1 sediment sample, and 1 surface water sample. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Garage (SS10) site are presented in Figure 4-3.

Thirteen soil samples were analyzed for DRPH and RRPH. In addition, 10 samples were analyzed for GRPH, BTEX, HVOCs, and PCBs. Four soil samples were analyzed for VOCs, and one sample was analyzed for SVOCs and total metals.

One sediment sample was analyzed for DRPH, GRPH, RRPH, HVOCs, BTEX, and PCBs.

One surface water sample was analyzed for DRPH, GRPH, RRPH, BTEX, VOCs, SVOCs, and total and dissolved metals.

4.3.2.2 Analytical Results. The data summary table (Table 4-6) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 4-3. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. Only metals detected above background levels that exceed an RBSL or ARAR are presented on Figure 4-3. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site.

Organics. Organic compounds detected in soil and sediment samples at the site include DRPH, GRPH, RRPH, BTEX compounds, one VOC, three SVOCs, and PCBs. DRPH were detected in ten soil samples at concentrations ranging from 70 to 75,000 mg/kg. GRPH were detected in six soil samples at concentrations ranging from 130 to 1,500 mg/kg. RRPH were detected in six soil/sediment samples ranging from 120 to 52,000 mg/kg. BTEX (total) compounds were detected in four soil samples at concentrations ranging from 8.3 to 38.3 mg/kg; ethylbenzene and xylenes were the primary components. One VOC (tetrachloroethene) was detected in soil sample SS10-S02 at 5.2 mg/kg. Three SVOCs (fluoranthene, pyrene, and bis(2-ethylhexyl)phthalate) were detected in soil sample SS10-S02 at concentrations ranging from 5.32 to 6.77 mg/kg. PCBs (Aroclor 1254) were detected in soil sample SS10-S04 at 3 mg/kg.

No organic compounds were detected in the surface water samples collected at the site.

Inorganics. Metals analyses indicated that two metals (lead and zinc) were detected above background concentrations in soil sample SS10-S02 (48 and 130 mg/kg, respectively). In the surface water sample, one metal (barium) was detected above background concentrations at 290 μg/L.

4.3.2.3 Summary of Site Contamination. The primary contaminants at the site are petroleum hydrocarbons (DRPH, GRPH, RRPH, and BTEX), low levels of Aroclor 1254, a solvent, and three SVOCs. Metals detected in soil/sediment and surface water at the site were evaluated in the risk assessment, and site concentrations were determined not to be significant. The suspected source of contaminants detected during sampling conducted at the Garage is POL wastes discharged to the floor drains in the Garage. The floor drains were sealed by the Air Force in 1993 to prevent further release of contaminants. The human health and ecological risks associated with chemicals detected at the site are presented in Section 4.3.4 and 4.3.5.

Based on field data, source of contamination, and concentration of contaminants, the contaminated area at the site includes approximately 20,000 square feet of gravel located adjacent to the Gasoline Storage Area site, 1,333 square feet of tundra south and northwest of the Garage, and 2,222 square feet of soil below the building.

4.3.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

4.3.3.1 Topography and Stratigraphy. The site consists of a gravel pad placed on relatively flat tundra that surrounds the Garage building on the north, east, and south sides. The gravel pad, which is approximately four feet thick, provides the greatest topographic relief at the site. Drainage is generally radial away from the gravel pad to the tundra where it flows through a series of ephemeral streams towards the east.

During the 1993 RI, permafrost was located at a depth of approximately two feet in tundra areas and four feet under gravel pads. Gravel pads consisted of the typical gravels and sands, and subsurface tundra materials were of the typical stratigraphy associated with these features (Section 2.4.4.2).

4.3.3.2 Migration Potential.

Subsurface Migration. Analytical data indicate that the subsurface has been affected by site contaminants; however, the potential for contaminant migration in active layer water at this site is low. Site topography dictates that subsurface flow in this area should generally be to the west. Analytical data indicate that contaminants have migrated in the gravel pad on the north portion of the site. The contaminants and concentrations in the gravel pad surrounding the Garage are similar to those detected at the Gasoline Storage Area site and are suspected to be due to previous gasoline storage activities conducted at the Gasoline Storage Area site. Topography indicates that the contaminants in the gravel pad will migrate radially out towards the tundra.

Surface Migration. The site topography indicates that surface water should drain either through the culvert to the east or west through the open end of the Garage. Analytical results indicate that contaminants have migrated in both directions. The lack of significant contaminant concentrations in surface water samples indicate that this may no longer be an active migration pathway. Therefore, the potential for contaminant migration is considered low.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Analytical results indicate that the surface and subsurface migration pathways have been active at this site. Although contaminated soil/sediment is present at the site, the lack of significant contaminants in surrounding surface water suggests that significant migration is no longer occurring. Because the surrounding terrain is flat and marshy and there was no significant contamination in surface water associated with the site, the potential for significant surface or subsurface migration from this site is considered to be low.

4.3.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Garage (SS10) site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in soil/sediments and surface water at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, incidental ingestion of soil/sediment, and ingestion of surface water. Because ground water and air at the Oliktok Point sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Oliktok Point Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the

installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with chemicals at the site are presented in Section 4.3.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Oliktok Point Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Oliktok Point installation. Because of the diversity of the plants and animals in the area of the Oliktok Point installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Tables 2-6 and 2-7.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Oliktok Point. The potential ecological risks associated with the chemicals detected at the site are presented in Section 4.3.5.

4.3.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Garage (SS10) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

4.3.4.1 Chemicals of Concern. DRPH, GRPH, RRPH, benzene, tetrachloroethane, bis(2-ethylhexyl)phthalate, and Aroclor 1254 were identified as COCs for the soil matrix at the Garage site. The maximum concentrations of DRPH, GRPH, and RRPH exceeded their ARAR concentrations for petroleum hydrocarbon contamination of soil (ADEC 1991). The maximum concentration of benzene exceeded the background concentration, the RBSL based on cancer risk, and the ARAR based on ADEC (1991). Tetrachloroethene and bis(2-ethylhexyl)phthalate exceeded the RBSLs based on cancer risk but not the RBSLs based on noncancer hazard. Aroclor 1254 exceeded the background concentration and the RBSLs based on cancer risk and noncancer hazard but not the ARAR promulgated under TSCA.

Barium was identified as a COC for the surface water at the Garage. The maximum concentration of barium exceeded the background concentration and the RBSL based on noncancer hazard. Barium did not exceed the ARAR, which is an MCL promulgated under the Safe Drinking Water Act.

Table 4-6, Identification of COCs at the Garage (SS10), presents the maximum concentrations of chemicals detected at the site, the associated background concentrations, RBSLs, and ARARs, and the COCs selected in the risk evaluation.

4.3.4.2 Exposure Pathways and Potential Receptors. Because COCs were identified for soil/sediment and surface water at the site, the potential risks associated with ingestion of soil/sediment and surface water were evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

4.3.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Garage by a hypothetical native northern adult/child is 2, and by a DEW Line worker is 0.1, based on the maximum concentrations of the COCs. The presence of DRPH, GRPH, RRPH, tetrachloroethene, bis(2-ethylhexy)phthalate, and Aroclor 1254 accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations. DRPH and RRPH together account for more than 90 percent of the noncancer hazard.

The excess lifetime cancer risk associated with the ingestion of soil or sediment at the site by a hypothetical native northern adult/child is 5×10^{-6}, and by a DEW Line worker is 2×10^{-7}, based on the maximum concentration of the carcinogenic COCs. The presence of GRPH, benzene, tetrachloroethene, bis(2-ethylhexyl)phthalate, and Aroclor 1254 accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Aroclor 1254 alone accounts for about 90 percent of the cancer risk.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the Garage by a hypothetical native northern adult or a DEW Line work is 0.06, based on maximum concentration of the COC. The presence of barium accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

No carcinogenic COCs were identified for the surface water at the Garage; therefore, the excess lifetime cancer risk associated with ingestion of surface water cannot be quantified.

Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Garage site are the noncancer hazard (hazard indices of 2 and 0.1) and cancer risk associated with the carcinogenic COCs. Although the estimated hazard index of two

exceeds one, it was calculated based on several conservative assumptions. It is based primarily on the maximum concentrations of DRPH and RRPH detected in individual soil/sediment samples and assumes the concentrations are homogeneously distributed throughout the site. It assumes the exposure concentrations will remain constant over the calculated exposure period of 55 years. In addition, these risks and hazards were calculated conservatively based on ingestion of soil at a rate associated with a potential future residential scenario. It is very unlikely that the soil at this location would be ingested at the conservative rate used in the risk calculation, and the hazards and risks at the site are likely to be overestimated. Therefore on the basis of the human health risk assessment, remediation of the site is not necessarily warranted.

A low hazard index of 0.06 is associated with the COCs in surface water at the site, indicating a minimal noncancer risk. No carcinogenic COC was identified for the surface water at the Garage. Remediation is not generally required at sites where the noncancer hazard does not exceed one. In addition, this potential risk was calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the chemicals in surface water do not currently pose a health hazard nor are they likely to pose a hazard in the future. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not known to be used as a water supply now, nor has it been used in the past.

In conclusion, under current uses, the COCs identified in surface water and soil/sediment at the Garage (SS10) site pose only a minimal, if any, potential threat to human health. The cancer risks and noncancer hazards calculated for soil/sediment and surface water at the site are below levels at which remediation is usually required. Based on the human health risk assessment, remedial actions are not warranted at the site.

4.3.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the Oliktok Point installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

4.3.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. All sites at the installation were considered as potentially usable habitat. It should be noted that the COC selection process only considered the soil/sediment samples that were at or less than 1.5 feet deep. The soil/sediment samples were screened for depth because it is unlikely that any of the representative species will be exposed to soils/sediments deeper than 1.5 feet. No COCs were identified in surface water at the site. The COCs in soils/sediments at the Garage site were DRPH, benzene, toluene, ethylbenzene, xylenes, PCBs, and lead. None of the identified COCs were associated with significant ecological risk estimates at the Garage site.

4.3.5.2 Summary of Ecological Risk Assessment. Based on the quantification of potential risks to ecological receptors and discussions presented in the Oliktok Point ERA,

ecological risks at the Garage site are not significant. There is a possibility that PCBs may bioaccumulate in the food chain. Although PCB concentrations do not currently pose a significant risk, they may present a risk to ecological receptors in the future as a result of potential bioaccumulation. However, PCBs were detected in only one of ten site samples and at a relatively low level, so potential bioaccumulation is minimal.

4.3.6 Conclusions and Recommendations

Sampling and analyses have determined that the Garage (SS10) site is contaminated with petroleum hydrocarbons (DRPH, GRPH, and RRPH), VOCs (including BTEX), and SVOCs that are primarily associated with gasoline and diesel fuels, a solvent, and Aroclor 1254. Surface and subsurface contaminant migration has occurred at the site. The affected area includes tundra west and south of the Garage, the soil underneath the building, and the gravel pad north of the Garage adjacent to the Gasoline Storage Area (the volume of gravel from the Gasoline Storage Area has been combined with gravels from the Garage in the evaluation for the FS).

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. The ERA concluded that the overall potential risks presented by site contaminants are low. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of DRPH, GRPH, RRPH, and BTEX detected in gravel, soil, and tundra at the site, however, exceed ADEC guidance cleanup levels. Therefore, the site is being recommended for remedial action. The affected volume at the site includes approximately 3,333 cubic yards of gravel, 222 cubic yards of tundra west and south of the Garage, and 370 cubic yards of soil beneath the structure. The remedial action alternative recommended for the tundra, gravel, and soils beneath the structure at the site is enhanced bioremediation. A complete description and evaluation of the remedial alternatives considered for this site are presented in the FS, Section 5.0.

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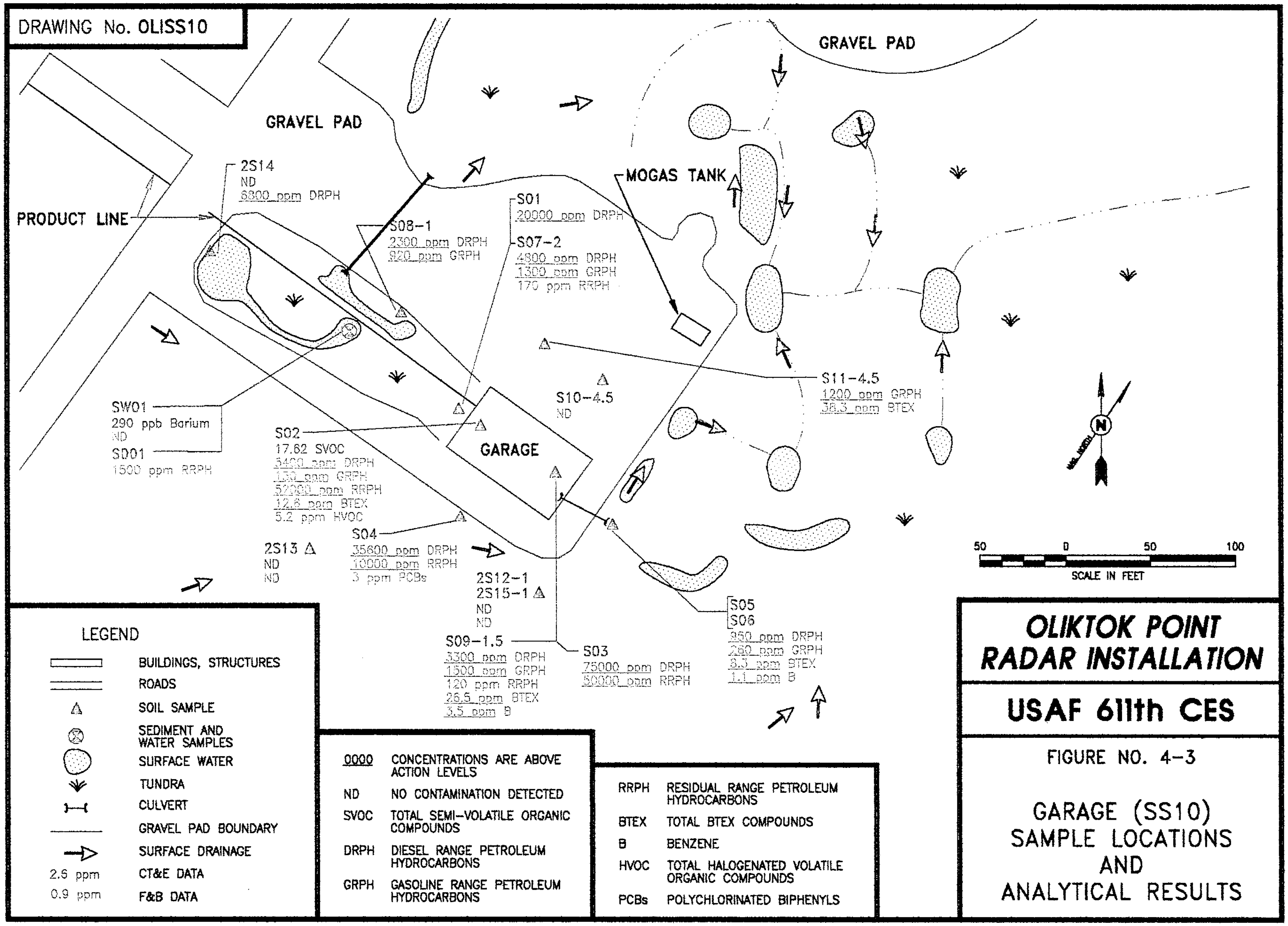
DRAWING No. OLISS10
GRAVEL PAD
GRAVEL PAD
PRODUCT LINE
2S14
ND
6800 ppm DRPH
S08-1
2300 ppm DRPH
920 ppm GRPH
S01
20000 ppm DRPH
S07-2
4800 ppm DRPH
1300 ppm GRPH
170 ppm RRPH
MOGAS TANK
S11-4.5
1200 ppm GRPH
38.3 ppm BTEX
S10-4.5
ND
SW01
290 ppb Barium
ND
SD01
1500 ppm RRPH
S02
17.62 SVOC
5400 ppm DRPH
130 ppm GRPH
52000 ppm RRPH
12.8 ppm BTEX
5.2 ppm HVOC
GARAGE
S04
35600 ppm DRPH
10000 ppm RRPH
3 ppm PCBs
2S13
ND
ND
2S12-1
2S15-1
ND
ND
S09-1.5
3300 ppm DRPH
1500 ppm GRPH
120 ppm RRPH
26.5 ppm BTEX
3.5 ppm B
S03
75000 ppm DRPH
50000 ppm RRPH
S05
S06
950 ppm DRPH
260 ppm GRPH
8.3 ppm BTEX
1.1 ppm B
N
50
0
50
100
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
SEDIMENT AND WATER SAMPLES
SURFACE WATER
TUNDRA
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
SVOC TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
B BENZENE
HVOC TOTAL HALOGENATED VOLATILE ORGANIC COMPOUNDS
PCBs POLYCHLORINATED BIPHENYLS
OLIKTOK POINT RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 4-3
GARAGE (SS10) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY

Installation: Oliktok Point Site: Garage (SS10) Matrix: Soil Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					S01	S02	S03	S04	S05 & S06 (Replicates)		AB02	EB04	TB04		
Laboratory Sample ID Numbers					282	284 4264-3	286	288	290	292	4263-4	254/257 4263-6	252 4263-5	#5-82193 #1&2-82193 4263	#5-82193 #1&2-82193 4264
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	13.8J[d]-167J[d]	20,000J[b]	54,000J[b]	75,000J[b]	35,600J[b]	950J[b]	70J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.1-5	1-50	100	<0.600-<1.00	<1[b]	130J[b]	<400J[b]	<25J[b]	280J[b]	240J[b]	NA	<50J[b]	<1J[b]	<50	<1
RRPH (Approx.)	10	100	2,000[a]	NA	<100	52,000	50,000	10,000	<100	<100	NA	<1,000	NA	<1,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<0.10	12.64J	<25.64	<13.64	3.7J	8.34J					
Benzene	0.002-0.004	0.02-0.04	0.5	<0.030-<0.060	<0.02	<0.02	<0.04	<0.04	1.1J	0.54J	<1[c]	<1	<1	<1	<0.02
Toluene	0.002-0.06	0.02-0.6		<0.030-<0.060	<0.02	0.04	<0.6	<0.4	0.6	1.8	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.22	0.02-2.2		<0.030-<0.060	<0.02	9.5	<0.3	<2.2	0.5	3.5	<1[c]	<1	<1	<1	<0.02
Xylenes (Total)	0.004-2.3	0.04-23		<0.060-<0.120	<0.04	3.1J	<23	<11	1.5J	2.5J	<2[c]	<2	<2	<2	<0.04
HVOC 8010															
Tetrachloroethene	0.002-1.8	0.02-18		NA	<0.02	5.2J	<0.02	<18	<0.02	<0.02	NA	<1	NA	<1	<0.02
VOC 8260	0.020	0.020		<0.030-<0.045	NA	<0.020	NA	NA	NA	NA	<1-2.8	<1-1.5	<1	<1	<0.020
SVOC 8270															
Fluoranthene	0.200	2.200		<0.330-<3.30	NA	6.77	NA	NA	NA	NA	NA	<22	NA	<10	<0.200
Pyrene	0.200	2.200		<0.330-<3.30	NA	5.32	NA	NA	NA	NA	NA	<22	NA	<10	<0.200
bis (2-Ethylhexyl) phthalate	0.200	2.200	50	<0.330-<3.30	NA	5.53	NA	NA	NA	NA	NA	<22	NA	<10	<0.200
PCBs															
Aroclor 1254	0.01	0.1	10	<0.030-<0.100	<0.1	<0.1	<0.1	3J	<0.1	<0.1	NA	<2	NA	<2	<0.1

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Garage (SS10)
Matrix: Soil
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					S02					EB04	
Laboratory Sample ID Numbers					4264-3					4263-6	4263 4264
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	2,100					<100	<100
Antimony	N/A	55		<7.8-<230	<55					<100	<100
Arsenic	0.11	5.5		<4.9-8.5	<5.5					<100	<100
Barium	0.024	1		27-390	130					<50	<50
Beryllium	N/A	2.8		<2.6-6.4	<2.8					<50	<50
Cadmium	0.33	2.8		<3.0-<36	<2.8					<50	<50
Calcium	0.69	4		360-59,000	5,600					<200	<200-378
Chromium	0.066	1		<4.3-47	7.6J					<50	<50
Cobalt	N/A	5.5		<5.1-12	<5.5					<100	<100
Copper	0.045	1		<2.7-45	18					<50	<50
Iron	0.50	2		5,400-35,000	7,300					<100	<100
Lead	0.13	2		<5.1-22	48					<100	<100
Magnesium	0.96	4		360-7,400	1,100					<200	<200
Manganese	0.025	1		25-290	94					<50	<50
Molybdenum	N/A	2.8		<2.5-<11	<2.8					<50	<50
Nickel	0.11	1		4.2-46	8.1					<50	<50

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Garage (SS10)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					S02					EB04	
Laboratory Sample ID Numbers					4264-3					4263-6	4263 4264
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Potassium	23	100		<300-2,200	370					<5,000	<5,000
Selenium	1.2	55		<7.8-<170	<55					<100	<100
Silver	0.53	2.8		<3-<110	<2.8					<50	<50
Sodium	0.55	5		<160-<680	200					<250	<250
Thallium	0.011	0.26		<0.2-<1.2	<0.26					<5	<5
Vanadium	0.036	1		6.3-59	8.5					<50	<50
Zinc	0.16	1		9.2-95	130					<50	<50

☐ CT&E Data.

TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Garage (SS10)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					S07-2	S08-1	S09-1.5	S10-4.5	S11-4.5	SD01	AB02	EB04	TB04		
Laboratory Sample ID Numbers					266	268	270	272	274	277/278	4263-4	254/257 4263-6	252 4263-5	#1&2-82193 #5-82193 4263	#5-82193 #1&2-82193
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-150	50-1,500	500[a]	13.8J[d]-167J[d]	4,800[b]	2,300[b]	3,300[b]	<60[b]	2,100[b]	<1,500[b]	NA	<1,000[b]	NA	<500	<50
GRPH	0.1-130	1-1,300	100	<0.600-<1.00	1,300J[b]	920J[b]	1,500J[b]	<440J[b]	1,200J[b]	<1,300J[b]	NA	<50J[b]	<1J[b]	<50	<1
RRPH (Approx.)	10	100	2,000[a]	NA	170	<120	120	<100	<100	1,500	NA	<1,000	NA	<1,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	<19.5J	<23.36J	26.5J	<0.83J	38.3J	<0.80J					
Benzene	0.002-0.27	0.02-2.7	0.5	<0.030-<0.060	<2.7J	<0.36J	3.5J	<0.14J	0.12J	<0.03J	<1[c]	<1	<1	<1	<0.02
Toluene	0.002-0.38	0.02-3.8		<0.030-<0.060	<3.8J	<1.1J	4.5	<0.09J	0.88	<0.1J	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.42	0.02-4.2		<0.030-<0.060	<4.2J	<2.9J	8.5	<0.2J	6.3	<0.32J	<1[c]	<1	<1	<1	<0.02
Xylenes (Total)	0.004-1.9	0.04-19		<0.060-<0.120	<8.8J	<19J	12J	<0.4J	31J	<0.35J	<2[c]	<2	<2	<2	<0.04
HVOC 8010	0.002	0.02		NA	<7.6J	<0.02	<0.02	<0.02	<0.02	<0.02	NA	<1	NA	<1	<0.02
PCBs	0.01-3	0.1-30	10	<0.030-<0.100	<0.1	<0.1	<0.1	<0.1	<0.1	<30	NA	<2	NA	<2	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point Matrix: Soil
Site: Garage (SS10) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: 2S12-1 & 2S15-1 (Replicates)		Environmental Samples: 2S13-1	Environmental Samples: 2S14	Field Blanks: AB02	Field Blanks: 2EB05	Field Blanks: 2TB05	Lab Blanks	
Laboratory Sample ID Numbers					1810 4628-1	1813 4628-4	1811 4628-2	1812 4628-3	4263-4	4628-6	4628-5	4263 4628	#5-9693 4628
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-7	60-70	500[a]	13.8J[d]-167J[d]	<60[b]	<70[b]	<60[b]	6,800J[b]	NA	NA	NA	NA	<50
RRPH (Approx.)	12-34	120-340	2,000[a]	NA	<120	<340	<120	<200	NA	NA	NA	NA	<1,000
VOC 8260	0.020	0.025-0.400		<0.030-<0.045	<0.030	<0.030	<0.025	<0.400	<1-2.8	<1-2.7	<1-6.8	<1	<0.020

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point Matrix: Surface Water
Site: Garage (SS10) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample				Field Blanks			Lab Blanks
					SW01				AB02	EB04	TB04	
Laboratory Sample ID Numbers					260/276 4263-7 4264-4				4263-4	254/257 4263-6	252 4263-5	#5-82193 #1&2-82193 4264 4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		392^{ad}-$457J^{ad}$	<1,000[b]				NA	<1,000[b]	NA	<1,000
GRPH	5	50		<20	<50J[b]				NA	<50J[b]	<1J[b]	<50
RRPH (Approx.)	100	1,000		NA	<1,000				NA	<1,000	NA	<1,000
BTEX (8020/8020 Mod.)												
Benzene	0.1	1	5	<1	<1				<1[c]	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1				<1[c]	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1				<1[c]	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2				<2[c]	<2	<2	<2
VOC 8260	1	1		<1	<1				<1-2.8	<1-1.5	<1	<1
SVOC 8270	10	22		<10	<22				NA	<22	NA	<10

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point   Matrix: Surface Water   METALS ANALYSES: TOTAL
Site: Garage (SS10)   Units: µg/L   (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blanks
					SW01						EB04	
Laboratory Sample ID Numbers					4264-4						4263-6	4264 4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)						<100	<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)						<100	<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)						<100	<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	290 (260)						<50	<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)						<50	<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	77,000 (75,000)						<200	<200-378 (378)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)						<100	<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)						<50	<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	2,200 (230)						<100	<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Garage (SS10)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blanks
					SW01						EB04	
Laboratory Sample ID Numbers					4264-4						4263-6	4264 4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Lead	6.6	100	15	<100 (<100)	<100 (<100)						<100	<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	29,000 (27,000)						<200	<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	120 (<50)						<50	<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)						<50	<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)						<50	<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)						<5,000	<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)						<100	<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)						<50	<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	100,000 (87,000)						<250	<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)						<5	<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 4-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point Matrix: Surface Water METALS ANALYSES: TOTAL
Site: Garage (SS10) Units: µg/L (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Field Blank	Lab Blanks
					SW01						EB04	
Laboratory Sample ID Numbers					4264-4						4263-6	4264 4263
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Zinc	8.2	50		<50-160 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.

TABLE 4-6. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE GARAGE (SS10)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Garage (SS10)	Soil/Sediment	DRPH	75,000J	mg/kg	13.8J-167J	--	--	500[c]	**Yes**
		GRPH	1,500J	mg/kg	<0.600-<1.00	--	--	100[c]	**Yes**
		RRPH	52,000	mg/kg	NA	--	--	2,000[c]	**Yes**
		Benzene	3.5J	mg/kg	<0.030-<0.060	2.2	--	0.5[c]	**Yes**
		Toluene	4.5	mg/kg	<0.030-<0.060	--	5,400	--	No
		Ethylbenzene	9.5	mg/kg	<0.030-<0.060	--	2,700	--	No
		Xylenes (Total)	31J	mg/kg	<0.060-<0.120	--	54,000	--	No
		Tetrachloroethene	5.2J	mg/kg	NA	1.23	270	--	**Yes**
		Fluoranthene	6.77	mg/kg	<0.330-<3.30	--	1,080	--	No
		Pyrene	5.32	mg/kg	<0.330-<3.30	--	810	--	No
		bis (2-Ethylhexyl) Phthalate	5.53	mg/kg	<0.330-<3.30	4.57	540	--	**Yes**
		Aroclor 1254	3J	mg/kg	<0.030-<0.100	0.0083	0.54	10[d]	**Yes**
		Aluminum	2,100	mg/kg	1,500-25,000	--	--	--	No
		Barium	130	mg/kg	27-390	--	1,890	--	No
		Calcium	5,600	mg/kg	360-59,000	--	--	--	No
		Chromium	7.6J	mg/kg	<4.3-47	--	135	--	No
		Copper	18	mg/kg	<2.7-45	--	999	--	No
		Iron	7,300	mg/kg	5,400-35,000	--	--	--	No
		Lead	48	mg/kg	<5.1-22	--	--	500[e]	No
		Magnesium	1,100	mg/kg	360-7,400	--	--	--	No
		Manganese	94	mg/kg	25-290	--	3,780	--	No
		Nickel	8.1	mg/kg	4.2-46	--	540	--	No
		Potassium	370	mg/kg	<300-2,200	--	--	--	No
		Sodium	200	mg/kg	<160-<680	--	--	--	No

TABLE 4-6. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE GARAGE (SS10) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Garage (SS10)	Soil/Sediment	Vanadium	8.5	mg/kg	6.3-59	--	189	--	No
(Continued)	(Continued)	Zinc	130	mg/kg	9.2-95	--	8,100	--	No
	Surface Water[g]	Barium	290	µg/L	<50-93	--	256	2,000[f]	**Yes**
		Calcium	77,000	µg/L	4,500-88,000	--	--	--	No
		Iron	2,200	µg/L	180-2,800	--	--	--	No
		Magnesium	29,000	µg/L	<5,000-53,000	--	--	--	No
		Manganese	120	µg/L	<50-510	--	18.3	--	No
		Sodium	100,000	µg/L	8,400-410,000	--	--	--	No

NA Not analyzed.
a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.
d TSCA cleanup level.
e EPA 1991c.
f MCL, 56 FR 30266 (01 January 1991).
g The concentrations reported for metals in surface waters are total metals.
J Result is an estimate.

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4.4 Old Sewage Area Petroleum Spill (SS11)

4.4.1 Site Background

This site consists of tundra and gravel pad areas located approximately 200 feet north and northeast of the Module Train. The old sewage area is located north of the module train at the terminus of an old sewage outfall pipe. To the west of the outfall pipe are tundra and gravel pad areas where a petroleum spill is suspected. This area is just south of the installation's diesel tanks.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 4.4.3.

4.4.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Old Sewage Area Petroleum Spill (SS11) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

4.4.2.1 Summary of Samples Collected. A total of 17 samples was collected at the site. These consisted of six soil, eight sediment, and three surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Old Sewage Area Petroleum Spill (SS11) site are presented in Figure 4-4.

Six soil samples were analyzed for DRPH and RRPH. In addition, two samples were analyzed for BTEX and GRPH.

Eight sediment samples were analyzed for DRPH, GRPH, BTEX, VOCs (8010), and PCBs. In addition, two samples were analyzed for VOCs, SVOCs (8260), pesticides, and total metals.

Three surface water samples were analyzed for DRPH, GRPH, BTEX, and VOCs (8010). In addition, one sample was analyzed for VOCs (8260), SVOCs, pesticides, total and dissolved metals, TOC, TSS, and TDS.

4.4.2.2 Analytical Results. The data summary table (Table 4-7) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 4-4. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. Only metals detected above background levels that exceed an RBSL or ARAR are presented on Figure 4-4. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil and sediment samples collected at the site include DRPH, GRPH, BTEX, eight other VOCs, four SVOCs, and PCBs. DRPH were detected in 11 soil/sediment samples at concentrations ranging from 15.5 to 2,990 mg/kg. GRPH were detected in eight samples ranging from 0.265 to 389 mg/kg. BTEX (total) were detected in six soil/sediment samples at concentrations ranging from 0.098 to 23 mg/kg; xylenes were the primary component. Eight other VOCs, which are primarily common components of diesel fuel, were detected in replicate sediment samples, SS11-SD01/SD09, at concentrations ranging from 0.504 to 21.3 mg/kg; 1,2,4-trimethylbenzene was the primary component. Four SVOCs were detected in two sediment samples at very low concentrations ranging from 0.451 to 2.50 mg/kg. PCBs (Aroclor 1254) were detected in four sediment samples at very low concentrations (0.020 to 0.045 mg/kg).

In surface water samples, organic compounds detected include DRPH, GRPH, BTEX, and six other VOCs. DRPH were detected in all three samples ranging from 416 to 1,110 mg/kg. GRPH, ethylbenzene, and xylenes were detected in duplicate surface water sample SS11-SW03/SW04 at 142; 5.3; and 7.7 mg/kg, respectively. Six other VOCs were detected in the same surface water sample at concentrations ranging from 1.1 to 31 µg/L. The primary components were 1,2,4-trimethylbenzene (31 mg/kg) and 1,3,5-trimethylbenzene (13 mg/kg); both are common components of diesel fuel.

Inorganics. Metals analyses indicated that one metal (zinc) was detected above background concentration in sediment sample SS11-SD05 at 110 mg/kg.

In the surface water sample, ten metals (aluminum, barium, calcium, copper, iron, lead, manganese, potassium, vanadium, and zinc) were detected above background concentrations. The respective concentrations are presented in Table 4-7.

TOC, TSS, and TDS were detected at 124,000; 1,070,000; and 892,000 µg/L, respectively, in surface water sample SS11-SW03/SW04.

4.4.2.3 Summary of Site Contamination. The primary contaminants at the site are petroleum hydrocarbons (DRPH, GRPH, and RRPH) and VOCs (including BTEX) commonly associated with diesel fuel. Low levels of some solvents and very low levels of Aroclor 1254 were also detected. The metals detected at the site were evaluated in the risk assessment, and risks or hazards associated with the metals are discussed in Sections 4.4.4 and 4.4.5. The suspected source of the contaminants detected during sampling conducted at the Old Sewage Area Petroleum Spill is spills and/or leak associated with the POL tank fill line and the day tanks in the module train. No previous IRP sampling is known to have been conducted at the site.

The human health and ecological risks associated with chemicals detected at the site are presented in Section 4.4.4 and 4.4.5. Based on field data, source of contamination, and concentration of contaminants, the area of affected soil at the site is limited to 4,444 square feet of tundra in localized areas east and west of the gravel pad and below the module train.

4.4.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

4.4.3.1 Topography and Stratigraphy. The site consists of a large gravel pad, approximately three feet thick, placed on the tundra. The gravel pad surrounds the module train located in the south portion of the site. Northwest of the module train, the gravel pad expands to the north. A gravel mound was located on the north portion of the gravel pad during the 1993 RI. The gravel pad is surrounded by tundra. The tundra west of the gravel pad generally drains to the west, and the tundra north of the module train drains north to the Beaufort Sea. The topography in this area is generally flat. The gravel pad, gravel mound, and adjacent road provide the greatest relief at the site.

During the 1993 RI, permafrost was located at a depth of approximately two feet in tundra areas and four feet under gravel pads. Gravel pads consisted of the typical gravels and sands, and subsurface tundra materials were of the typical stratigraphy associated with these features (Section 2.4.4.2).

4.4.3.2 Migration Potential.

Subsurface Migration. The site topography indicates that active layer water flow should be very sluggish. It should generally follow the surface contours and flow radially out from the gravel pad to the tundra. At the west edge of the gravel pad at the site are tundra ponds that should receive active layer water from the gravel pad. Affected active layer water that enters these water bodies no longer presents a potential for subsurface migration, but a potential for surface migration is then created. Due to the flat topography and the underlying permafrost, the potential of subsurface migration of contaminants is low.

Surface Migration. The primary route of surface migration over the gravel pad portion of the site is overland sheet flow. Significant surface migration over the gravel pad area is probably restricted to the spring thaw when large quantities of meltwater are available and the frozen ground prevents active layer flow. Surface migration on the gravel pad will follow surface contours, which are generally west and northwest from the gravel pad out to the tundra and surface water bodies that border the site.

Bordering the gravel pad to the west is a tundra area where surface water migrates through a series of tundra ponds connected by sluggish ephemeral streams. Adjacent to the gravel pad is a large tundra pond, which receives most of the runoff from the gravel pad. Due to the flat topography, underlying permafrost, and adjacent gravel pad, the potential for surface migration of contaminants from this portion of the site is low. North of the module train, the tundra slopes gently to the north, and drainage pathways lead north from the ends of both of the culverts/pipes leading from the module train. Surface water samples collected from this area indicate that this is an active migration pathway, and the potential for contaminant migration is considered moderate.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Analytical results indicate that contaminant migration is occurring to a limited degree in the surface water at the site. The topography indicates that any surface migration west of the site will be sluggish, but north of the gravel pad the gently sloping tundra increases the flow of surface migration, thus increasing the potential for contaminated migration.

4.4.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Old Sewage Area Petroleum Spill (SS11) site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, incidental ingestion of soil/sediment, and ingestion of surface water. Because ground water and air at the Oliktok Point sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Oliktok Point Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with chemicals at the site are presented in Section 4.4.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Oliktok Point Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Oliktok Point installation. Because of the diversity of the plants and animals in the area of the Oliktok Point installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Tables 2-6 and 2-7.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Oliktok Point. The potential ecological risks associated with the chemicals detected at the site are presented in Section 4.4.5.

4.4.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Old Sewage Area Petroleum Spill (SS11) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

4.4.4.1 Chemicals of Concern. DRPH, GRPH, and Aroclor 1254 were identified as COCs for the soil matrix at the Old Sewage Area Petroleum Spill. The maximum concentrations of DRPH and GRPH exceeded the background concentrations and the ARAR concentrations for petroleum hydrocarbon contamination of soil (ADEC 1991). Aroclor 1254 exceeded the RBSL based on cancer risk.

DRPH, GRPH, 1,2-dichloroethane, barium, copper, lead, manganese, and vanadium were identified as COCs for the surface water at the Old Sewage Area Petroleum Spill site. The maximum concentrations of DRPH, barium, copper, manganese, and vanadium exceeded their background concentrations and RBSLs based on noncancer hazard. GRPH and 1,2-dichloroethane exceeded their RBSLs based on cancer risk. The maximum concentration of lead exceeded the ARAR, which is an MCL promulgated under the federal Safe Drinking Water Act (see Lead and Copper Rule of the SDWA). Barium and copper did not exceed their ARARs based on MCLs.

Table 4-8, Identification of COCs at the Old Sewage Area Petroleum Spill (SS11), presents the maximum concentrations of chemicals detected at the site, the associated background concentrations, RBSLs, ARARs, and the COCs selected in the risk evaluation.

4.4.4.2 Exposure Pathways and Potential Receptors. Because COCs were identified for soil/sediment and surface water at the site, the potential risks associated with ingestion of soil/sediment and surface water were evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

4.4.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Old Sewage Area Petroleum Spill by a hypothetical native northern adult/child is 0.08, and by a DEW Line worker is 0.004, based on the

maximum concentrations of the COCs. The presence of DRPH, GRPH, and Aroclor 1254 accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil or sediment at the site by a hypothetical native northern adult/child is 2×10^{-7}, and by a DEW Line worker is 8×10^{-9}, based on the maximum concentration of the carcinogenic COCs. The presence of GRPH and Aroclor 1254 accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the Old Sewage Area Petroleum Spill (SS11) site by a hypothetical native northern adult and by a DEW Line worker is eight, based on the maximum concentrations of the COCs. The presence of DRPH, GRPH, barium, copper, manganese, and vanadium accounts for the quantifiable noncancer hazard for these receptor/pathway combinations. Manganese alone accounts for more than 99 percent of the noncancer hazard.

The excess lifetime cancer risk associated with the ingestion of surface water at this site by a hypothetical native northern adult is 6×10^{-6}, and by a DEW Line worker is 1×10^{-6}, based on the maximum concentrations of the COCs. The presence of GRPH and 1,2-dichloroethane accounts entirely for excess lifetime cancer risk for these receptor/pathway combinations.

Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Old Sewage Area Petroleum Spill are the very low noncancer hazard (hazard indices of 0.08 and 0.004) and the very low cancer risk associated with GRPH and Aroclor 1254. These risks and hazards were calculated conservatively based on ingestion of soil at a rate associated with a residential scenario. It is very unlikely that the soil at this location would be ingested at the conservative rate used in the risk calculation, and the hazards and risks at the site are likely to be overestimated. Remedial action is generally not warranted at sites where the excess lifetime cancer risk is less than 1×10^{-6} and the noncancer hazards do not exceed one (EPA 1991b), and on the basis of the human health risk assessment remediation of the site is not warranted.

The potential risks and hazards associated with the surface water at the Old Sewage Area Petroleum Spill site are the noncancer hazard (hazard index of eight) and low cancer risk associated with the carcinogenic COCs at the site. Although the estimated hazard index of eight exceeds one, it was calculated based on several conservative assumptions. It is based primarily on the maximum concentration of manganese detected in one surface water sample and assumes this concentration is homogeneously distributed throughout the site. It assumes the exposure concentration will remain constant over the calculated exposure period of 55 years. In addition, the potential risks and hazards were calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not known to be used as a water supply now, nor has it been used in the past. Therefore, the hazards and risks at the site are likely to be overestimated because they are based on a potential future residential scenario. On

the basis of the human health risk assessment, remediation of the site is not necessarily warranted.

4.4.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the Oliktok Point installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

4.4.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. All sites at the installation were considered as potentially usable habitat. It should be noted that the COC selection process only considered the soil/sediment samples that were at or less than 1.5 feet deep. The soil/sediment samples were screened for depth because it is unlikely that any of the representative species will be exposed to soils/sediments deeper than 1.5 feet. DRPH were identified as a COC in surface water. The COCs in soil/sediment at the Old Sewage Area Petroleum Spill site were DRPH, benzene, toluene, ethylbenzene, xylenes, PCBs, and benzyl alcohol. None of the identified COCs were associated with significant ecological risk estimates at the Old Sewage Area Petroleum Spill site.

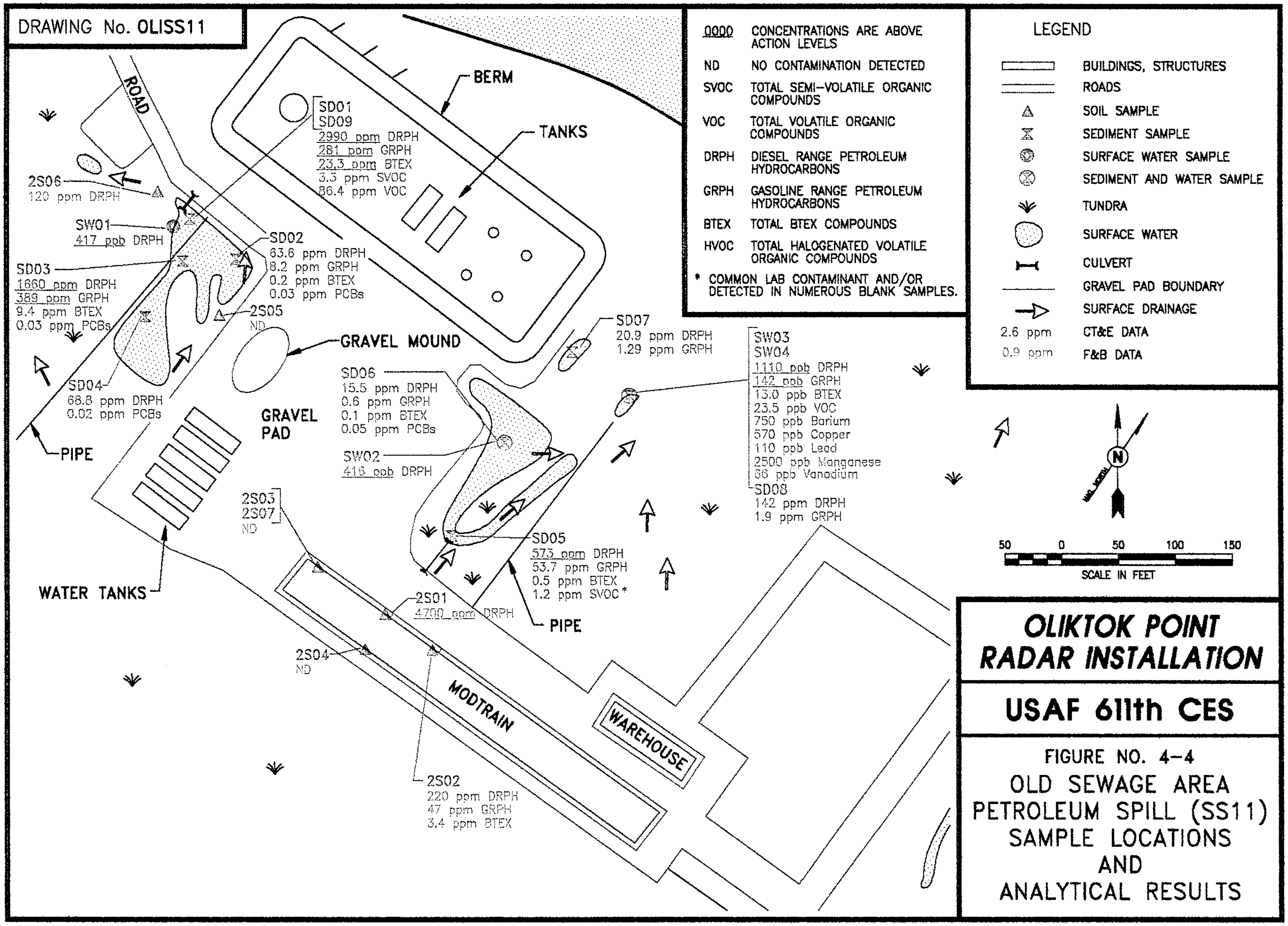
4.4.5.2 Summary of Ecological Risk Assessment. Based on the quantification of potential risks to ecological receptors and discussions presented in the Oliktok Point ERA, ecological risks at the Old Sewage Area Petroleum Spill site are not significant. There is a possibility that PCBs may bioaccumulate in the food chain. Although PCB concentrations do not currently pose a significant risk, they may present a risk to ecological receptors in the future as a result of potential bioaccumulation; however, based on the very low levels detected on site, this potential is low.

4.4.6 Conclusions and Recommendations

Sampling and analyses have determined that several small limited areas at the Old Sewage Area Petroleum Spill (SS11) site are contaminated with petroleum hydrocarbons (DRPH, GRPH, RRPH), other VOCs (including BTEX) that are primarily associated with gasoline and diesel fuels, and solvents. The affected areas at the site are the tundra at the end of the old sewage outfall pipes, the soil beneath the module train, and the tundra on the west side of the gravel pad. The affected areas appear to be localized, and migration of contaminants from the site appears to be minimal.

The risk assessment concluded that risks posed to ecological receptors by site contaminants are minimal given current site uses. A potential human health hazard was identified in surface water from manganese. This potential is based on a future scenario in which the site surface water would be used as a role drinking water supply and probably overestimates the hazards and risks. Considering the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action [i.e, cancer risks $>1 \times 10^{-4}$ or noncancer hazard significantly greater than one (EPA 1991b)]. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of DRPH, GRPH, RRPH, and BTEX detected in tundra at the site, however, exceed ADEC guidance cleanup levels. Therefore, the site is being recommended for remedial action. The affected area at the site includes 741 cubic yards of tundra and disturbed tundra area below the module train. The recommended alternative for the site is enhanced bioremediation. A complete description and evaluation of the remedial alternatives considered for this site are presented in the FS, Section 5.0.



DRAWING No. OLISS11
ROAD
BERM
TANKS
SD01
SD09
2990 ppm DRPH
281 ppm GRPH
23.3 ppm BTEX
3.3 ppm SVOC
86.4 ppm VOC
2S06
120 ppm DRPH
SW01
417 ppb DRPH
SD02
63.6 ppm DRPH
8.2 ppm GRPH
0.2 ppm BTEX
0.03 ppm PCBs
SD03
1660 ppm DRPH
389 ppm GRPH
9.4 ppm BTEX
0.03 ppm PCBs
2S05
ND
GRAVEL MOUND
SD04
66.8 ppm DRPH
0.02 ppm PCBs
PIPE
GRAVEL PAD
SD06
15.5 ppm DRPH
0.6 ppm GRPH
0.1 ppm BTEX
0.05 ppm PCBs
SW02
416 ppb DRPH
SD07
20.9 ppm DRPH
1.29 ppm GRPH
SW03
SW04
1110 ppb DRPH
142 ppb GRPH
13.0 ppb BTEX
23.5 ppb VOC
750 ppb Barium
570 ppb Copper
110 ppb Lead
2500 ppb Manganese
86 ppb Vanadium
SD08
142 ppm DRPH
1.9 ppm GRPH
2S03
2S07
ND
SD05
573 ppm DRPH
53.7 ppm GRPH
0.5 ppm BTEX
1.2 ppm SVOC*
WATER TANKS
2S01
4700 ppm DRPH
PIPE
2S04
ND
MODTRAIN
WAREHOUSE
2S02
220 ppm DRPH
47 ppm GRPH
3.4 ppm BTEX
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
SVOC TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
HVOC TOTAL HALOGENATED VOLATILE ORGANIC COMPOUNDS
* COMMON LAB CONTAMINANT AND/OR DETECTED IN NUMEROUS BLANK SAMPLES.
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLE
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
N
50 0 50 100 150
SCALE IN FEET
OLIKTOK POINT RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 4-4
OLD SEWAGE AREA PETROLEUM SPILL (SS11) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					SD01 & SD09 (Replicates)		SD02	SD03	SD04	SD05	AB01	EB02	TB02		
Laboratory Sample ID Numbers					4217-6 4209-8	4209-10 4218-1	4217-9	4217-10	4217-11	4209-9 4217-12	4209-7 4214-6	4209-6 4214-5	4209-11 4214-7	4209 4214	4209 4218 4217
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500^a	13.8J^e-167J^e	1,360	2,990	63.6^d	1,660	68.8^c	573	NA	NA	NA	NA	<4.00
GRPH	0.400	0.600	100	<0.600-<1.00	281	249	8.18	389	<0.600	53.7	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	5.614	23.288	0.154	9.402	<0.15	0.455					
Benzene	0.020	0.025-0.135	0.5	<0.030-<0.060	0.025	0.038	<0.025	<0.135	<0.030	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.025-0.135		<0.030-<0.060	0.458	1.75	<0.025	0.872	<0.030	<0.020	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.025-0.135		<0.030-<0.060	0.961	2.85	0.029	2.02	<0.030	0.126	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.05-0.270		<0.060-<0.120	4.17	18.65	0.125	6.51	<0.060	0.329	<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.020-0.135		<0.030-<0.060	<0.020	<0.020	<0.025	<0.135	<0.030	<0.020	<1	<1	<1	<1	<0.020
VOC 8260															
n-Butylbenzene	0.020	0.230-0.275		<0.030-<0.045	8.07	5.18	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
sec-Butylbenzene	0.020	0.230-0.275		<0.030-<0.045	3.49	2.14	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.230-0.275		<0.030-<0.045	2.65	1.63	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
Isopropylbenzene	0.020	0.230-0.275		<0.030-<0.045	2.42	1.38	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
p-Isopropylbenzene	0.020	0.230-0.275		<0.030-<0.045	3.59	2.39	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
Naphthalene	0.020	0.230-0.275		<0.030-<0.045	9.30	6.66	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
n-Propylbenzene	0.020	0.230-0.275		<0.030-<0.045	5.49	3.15	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
Toluene	0.020	0.230-0.275		<0.030-<0.045	1.99	1.30	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020

□ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that 32.3 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
d The laboratory reported that 40.3 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: SD01 & SD09 (Replicates)		Environmental Samples: SD02	Environmental Samples: SD03	Environmental Samples: SD04	Environmental Samples: SD05	Field Blanks: AB01	Field Blanks: EB02	Field Blanks: TB02	Lab Blanks	
Laboratory Sample ID Numbers					4217-6 4209-8	4209-10 4218-1	4217-9	4217-10	4217-11	4209-9 4217-12	4209-7 4214-6	4209-6 4214-5	4209-11 4214-7	4209 4214	4209 4218 4217
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
1,2,4-Trimethyl-benzene	0.020	0.230-0.275		<0.030-<0.045	21.3	13.9	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
1,3,5-Trimethyl-benzene	0.020	0.230-0.275		<0.030-<0.045	9.84	6.30	NA	NA	NA	<0.230	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.460-0.550		<0.060-<0.090	18.29	11.70	NA	NA	NA	<0.460	<2	<2	<2	<2	<0.040
SVOC 8270															
Benzyl Alcohol	0.200	0.240-0.260		<0.330-<3.30	2.50	<0.240	NA	NA	NA	<2.00	NA	<10	NA	<10	<0.200
di-n-Butylphthalate	0.200	0.240-0.260	8,000	<0.330-<3.30	0.337	0.582	NA	NA	NA	0.701	NA	<10	NA	<10	<0.200
bis (2-Ethylhexyl) phthalate	0.200	0.240-0.260	50	<0.330-<3.30	0.504	0.425	NA	NA	NA	0.451	NA	<10	NA	<10	<0.200
Naphthalene	0.200	0.240-0.260		<0.330-<3.30	<0.260	0.852	NA	NA	NA	<0.230	NA	<10	NA	<10	<0.200
2-Methyl naphthalene	0.200	0.240-0.260		<0.330-<3.30	<0.260	2.23	NA	NA	NA	<0.230	NA	<10	NA	<10	<0.200
Pesticides	0.0010	0.001-0.035		<0.005-<0.100	<0.007-<0.035	<0.001-<0.030	NA	NA	NA	<0.002-<0.020	NA	NA	NA	NA	<0.001-<0.010
PCBs															
Aroclor 1254	0.020	0.020-0.035	10	<0.030-<0.100	<0.035	<0.030	0.029	0.030	0.020	<0.020	NA	NA	NA	NA	<0.01

☐ CT&E Data.
NA Not analyzed.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)
Matrix: Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank	Lab Blank
					SD01 & SD09 (Replicates)		SD05					EB02	
Laboratory Sample ID Numbers					4210-4	4210-8	4210-7					4210-3	4210
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	2,600	1,400	1,400					<100	<100
Antimony	N/A	56-68		<7.8-<230	<68	<56	<60					<100	<100
Arsenic	0.11	5.6-6.8		<4.9-8.5	<6.8	<5.6	<6.0					<100	<100
Barium	0.024	1		27-390	170	110	120					<50	<50
Beryllium	N/A	2.8-3.4		<2.6-6.4	<3.4	<2.8	<3.0					<50	<50
Cadmium	0.33	2.8-3.4		<3.0-<36	<3.4	<2.8	<3.0					<50	<50
Calcium	0.69	4		360-59,000	9,000	4,000	5,800					230	<200
Chromium	0.066	1		<4.3-47	6.0	3.2	3.2					<50	<50
Cobalt	N/A	5.6-6.8		<5.1-12	<6.8	<5.6	<6.0					<100	<100
Copper	0.045	1		<2.7-45	7.8	8.4	16					<50	<50
Iron	0.50	2		5,400-35,000	9,500	7,100	7,400					<100	<100
Lead	0.13	2-6.0		<5.1-22	18	12	<6.0					<100	<100
Magnesium	0.96	4		360-7,400	1,800	810	580					<200	<200
Manganese	0.025	1		25-290	150	110	79					<50	<50
Molybdenum	N/A	2.8-3.4		<2.5-<11	<3.4	<2.8	<3.0					<50	<50
Nickel	0.11	1		4.2-46	8.5	6.9	5.2					<50	<50

☐ CT&E Data.
N/A Not available.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)

Matrix: Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank	Lab Blank
					SD01 & SD09 (Replicates)		SD05					EB02	
Laboratory Sample ID Numbers					4210-4	4210-8	4210-7					4210-3	4210
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Potassium	23	100-300		<300-2,200	450	<280	<300					<5,000	<5,000
Selenium	1.2	5.6-6.8		<7.8-<170	<6.8	<5.6	<6.0					<100	<100
Silver	0.53	2.8-3.4		<3-<110	<3.4	<2.8	<3.0					<50	<50
Sodium	0.55	5		<160-680	240	200	130					570	<250
Thallium	0.011	0.29-0.33		<0.2-<1.2	<0.33	<0.29	<0.29					<5	<5
Vanadium	0.036	1		6.3-59	9.5	6.7	7.2					<50	<50
Zinc	0.16	1		9.2-95	35	32	110					<50	<50

☐ CT&E Data.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point — Matrix: Sediment
Site: Old Sewage Area Petroleum Spill (SS11) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					SD06	SD07	SD08		AB01	EB02	TB02		
Laboratory Sample ID Numbers					4217-13	4217-14	4217-15		4209-7 4214-6	4214-5	4209-11 4214-7	4209 4214	4217
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	13.8J[d]-167J[d]	15.5[c]	20.9[c]	142[c]		NA	NA	NA	NA	<4.00
GRPH	0.400	0.400	100	<0.600-<1.00	0.625	1.29	1.89		NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	0.098	<0.125	<0.125						
Benzene	0.020	0.025	0.5	<0.030-<0.060	<0.025	<0.025	<0.025		<1	<1	<1	<1	<0.020
Toluene	0.020	0.025		<0.030-<0.060	0.098	<0.025	<0.025		<1	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.025		<0.030-<0.060	<0.025	<0.025	<0.025		<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.050		<0.060-<0.120	<0.050	<0.050	<0.050		<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.025		<0.030-<0.060	<0.025	<0.025	<0.025		<1	<1	<1	<1	<0.020
PCBs													
Aroclor 1254	0.020	0.020-0.050	10	<0.030-<0.100	0.045	<0.020	<0.50		NA	NA	NA	NA	<0.020

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples							Field Blanks			Lab Blanks	
					2S01	2S02	2S03 & 2S07 (Replicates)		2S04	2S05	2S06	AB02	2EB05	2TB05		
Laboratory Sample ID Numbers					1835	1836	1838	1843	1839	1840	1842	4263-4	1844	1848	#1&2-9793	#5-9693 #1&2-9793
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-7	60-70	500[a]	13.8J[d]-167J[d]	4,700J[b]	220J[b]	<60[b]	<60[b]	<60[b]	<70[b]	120J[b]	NA	NA	NA	NA	<50
GRPH	0.1	1	100	<0.600-<1.00	NA	47J[b]	NA	NA	NA	<1J[b]	NA	NA	<50J[b]	<50J[b]	<50	<1
RRPH (Approx.)	14-16	140-160	2,000[a]	NA	<160	<140	<140	<160	<140	<160	<160	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.150-<0.300	NA	3.4J	NA	NA	NA	<0.16	NA					
Benzene	0.002	0.02	0.5	<0.030-<0.060	NA	<0.02	NA	NA	NA	<0.02	NA	<1[c]	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.030-<0.060	NA	<0.02	NA	NA	NA	<0.02	NA	<1[c]	<1	<1	<1	<0.02
Ethylbenzene	0.003	0.03		<0.030-<0.060	NA	1.2	NA	NA	NA	<0.03	NA	<1[c]	<2	<1	<1	<0.02-<0.03
Xylenes (Total)	0.009	0.09		<0.060-<0.120	NA	2.2J	NA	NA	NA	<0.09	NA	<2[c]	<5	<2	<2	<0.04-<0.09

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples SW01	Environmental Samples SW02	SW03 & SW04 (Duplicates)	SW03 & SW04 (Duplicates)	Field Blanks AB01	Field Blanks EB02	Field Blanks TB02	Lab Blanks
Laboratory Sample ID Numbers					4214-1	4214-2	4209-4 4210-1 4214-3	4209-5 4210-2 4214-4	4209-7 4214-6	4209-6 4214-5	4209-11 4214-7	4209 4210 4214
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	100		392[ad]-457J[ad]	417[ad]	416[ad]	1,030J[ad]	1,110J[ad]	NA	NA	NA	<100
GRPH	20	20		<20	<20	<20	142[a]	134[a]	NA	<20	NA	<20
BTEX (8020/8020 Mod.)												
Benzene	1	1	5	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	<1	<1	5.3	<1	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	<2	5.6[c]	7.7	<2	<2	<2	<2
VOC 8010												
1,2-Dichloroethane	1	1	5	<1	<1	<1	<1J	3.3J	<1	<1	<1	<1
VOC 8260												
1,4-Dichlorobenzene	1	1		<1	NA	NA	1.1	1.1	<1	<1	<1	<1
1,2-Dichloroethane	1	1	5	<1	NA	NA	<1.0J	1.5J	<1	<1	<1	<1
p-Isopropyltoluene	1	1		<1	NA	NA	5.3	5.2	<1	<1	<1	<1

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
c Result is indicative of o-xylene only.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02	SW03 & SW04 (Duplicates)		AB01	EB02	TB02	
Laboratory Sample ID Numbers					4214-1	4214-2	4209-4 4210-1 4214-3	4209-5 4210-2 4214-4	4209-7 4214-6	4209-6 4214-5	4209-11 4214-7	4209 4210 4214
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Naphthalene	1	1		<1	NA	NA	9.2	10	<1	<1	<1	<1
Toluene	1	1	1,000	<1	NA	NA	5.6	5.7	<1	<1	<1	<1
1,2,4-Trimethylbenzene	1	1		<1	NA	NA	30	31	<1	<1	<1	<1
1,3,5-Trimethylbenzene	1	1		<1	NA	NA	12	13	<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	NA	NA	7.9	8.5	<2	<2	<2	<1
SVOC 8270	10	10		<10	NA	NA	<10J	<10J	NA	<10J	NA	<10
Pesticides	0.05	0.1-1		<0.1-<2	NA	NA	<0.1-<1	NA	NA	NA	NA	<0.1-<1
PCBs	1	1	0.5	<1-<2	NA	NA	<1	NA	NA	NA	NA	<1
TOC	5,000	5,000		6,700-14,400	NA	NA	124,000	82,200	NA	NA	NA	<5,000
TSS	100	200		6,000-9,000	NA	NA	870,000	1,070,000	NA	NA	NA	<100
TDS	10,000	10,000		212,000-352,000	NA	NA	892,000	806,000	NA	NA	NA	<10,000

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank	Lab Blank
					SW03 & SW04 (Duplicates)						EB02	
Laboratory Sample ID Numbers					4210-1	4210-2					4210-3	4210
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	10,000 (<100)	17,000 (<100)					<100 (<100)	<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)	<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)	<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	470 (110)	750 (120)					<50 (<50)	<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (50)					<50 (<50)	<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (50)					<50 (<50)	<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	120,000 (110,000)	140,000 (111,000)					230 (<200)	<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)	<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)	<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	240 (<50)	570 (<50)					<50 (<50)	<50 (<50)
Iron	25	100		108-2,800 (<100-1,600)	41,000 (2,900)	64,000 (4,500)					<100 (<100)	792 (792)

☐ CT&E Data.
N/A Not available.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank	Lab Blank
					SW03 & SW04 (Duplicates)						EB02	
Laboratory Sample ID Numbers					4210-1	4210-2					4210-3	4210
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Lead	6.6	100	15	<100 (<100)	<100 (<100)	110 (<100)					<100 (<100)	<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	29,000 (27,000)	32,000 (27,000)					<200 (<200)	<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	2,000 (1,300)	2,500 (1,300)					<50 (<50)	<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)	<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)	82 (82)
Potassium	1,154	5,000		<5,000 (<5,000)	13,000 (12,000)	15,000 (13,000)					<5,000 (<5,000)	<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)	<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)	<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	110,000 (126,000)	110,000 (120,000)					570 (500)	250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)					<5 (<5)	<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)	66 (<50)					<50 (<50)	<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 4-7. OLD SEWAGE AREA PETROLEUM SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Oliktok Point
Site: Old Sewage Area Petroleum Spill (SS11)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples: SW03 & SW04 (Duplicates)						Field Blank: EB02	Lab Blank
Laboratory Sample ID Numbers					4210-1	4210-2					4210-3	4210
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Zinc	8.2	50		<50-160 (<50)	380 (<50)	840 (<50)					<50 (<50)	<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 4-8. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD SEWAGE AREA PETROLEUM SPILL (SS11)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Sewage Area Petroleum Spill (SS11)	Soil/Sediment	DRPH	4,700J	mg/kg	13.8J-167J	--	--	500[c]	**Yes**
		GRPH	389	mg/kg	<0.600-<1.00	--	--	100[c]	**Yes**
		Benzene	0.038	mg/kg	<0.030-<0.060	2.2	--	0.5[c]	No
		Toluene	1.99	mg/kg	<0.030-<0.045	--	5,400	--	No
		Ethylbenzene	2.85	mg/kg	<0.030-<0.060	--	2,700	--	No
		Xylenes (Total)	18.65	mg/kg	<0.060-<0.120	--	54,000	--	No
		n-Butylbenzene	8.07	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		sec-Butylbenzene	3.49	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		Isopropylbenzene	2.42	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		p-Isopropylbenzene	3.59	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		Naphthalene	9.30	mg/kg	<0.030-<0.045	--	1,100	--	No
		n-Propylbenzene	5.49	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		1,2,4-Trimethylbenzene	21.3	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		1,3,5-Trimethylbenzene	9.84	mg/kg	<0.030-<0.045	--	--	--	**Yes***
		Benzyl Alcohol	2.50	mg/kg	<0.330-<3.30	--	8,100	--	No
		di-n-Butylphthalate	0.582	mg/kg	<0.330-<3.30	--	2,700	--	No
		bis (2-Ethylhexyl) Phthalate	0.701	mg/kg	<0.330-<3.30	4.57	540	--	No
		2-Methylnaphthalene	2.23	mg/kg	<0.330-<3.30	--	--	--	**Yes***
		Aroclor 1254	0.045	mg/kg	<0.030-<0.100	0.00831	0.54	10[d]	**Yes**
		Aluminum	2,600	mg/kg	1,500-25,000	--	--	--	No
		Barium	170	mg/kg	27-390	--	1,890	--	No
		Calcium	9,000	mg/kg	360-59,000	--	--	--	No
		Chromium	6.0	mg/kg	<4.3-47	--	135	--	No
		Copper	16	mg/kg	<2.7-45	--	999	--	No

TABLE 4-8. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD SEWAGE AREA PETROLEUM SPILL (SS11) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
Old Sewage Area Petroleum Spill (SS11) (Continued)	Soil/Sediment (Continued)	Iron	9,500	mg/kg	5,400-35,000	--	--	--	No
		Lead	18	mg/kg	<5.1-22	--	--	500[e]	No
		Magnesium	1,800	mg/kg	360-7,400	--	--	--	No
		Manganese	150	mg/kg	25-290	--	3,780	--	No
		Nickel	8.5	mg/kg	4.2-46	--	540	--	No
		Potassium	450	mg/kg	<300-2,200	--	--	--	No
		Sodium	240	mg/kg	<160-680	--	--	--	No
		Vanadium	9.5	mg/kg	6.3-59	--	189	--	No
		Zinc	110	mg/kg	9.2-95	--	8,100	--	No
	Surface Water[j]	DRPH	1,110J	µg/L	392-457J	--	292	--	**Yes**
		GRPH	142	µg/L	<20	50	730	--	**Yes**
		Toluene	5.7	µg/L	<1	--	96.5	1,000[f]	No
		Xylenes (Total)	8.5	µg/L	<2	--	7,300	10,000[f]	No
		1,4-Dichlorobenzene	1.1	µg/L	<1	--	--	--	**Yes***
		1,2-Dichloroethane	3.3J	µg/L	<1	0.934	--	5[g]	**Yes**
		p-Isopropyltoluene	5.3	µg/L	<1	--	--	--	**Yes***
		Naphthalene	10	µg/L	<1	--	--	--	**Yes***
		1,2,4-Trimethylbenzene	31	µg/L	<1	--	--	--	**Yes***
		1,3,5-Trimethylbenzene	13	µg/L	<1	--	--	--	**Yes***
		Aluminum	17,000	µg/L	<100-350	--	--	--	No
		Barium	750	µg/L	<50-93	--	256	2,000[h]	**Yes**
		Calcium	140,000	µg/L	4,500-88,000	--	--	--	No
		Copper	570	µg/L	<50	--	135	1,300[i]	**Yes**
		Iron	64,000	µg/L	108-2,800	--	--	--	No
		Lead	110	µg/L	<100	--	--	15[i]	**Yes**

TABLE 4-8. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD SEWAGE AREA PETROLEUM SPILL (SS11) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Sewage Area Petroleum Spill (SS11) (Continued)	Surface Water[j] (Continued)	Magnesium	32,000	µg/L	<5,000-53,000	--	--	--	No
		Manganese	2,500	µg/L	<50-510	--	18.3	--	**Yes**
		Potassium	15,000	µg/L	<5,000	--	--	--	No
		Sodium	110,000	µg/L	8,400-410,000	--	--	--	No
		Vanadium	66	µg/L	<50	--	25.6	--	**Yes**
		Zinc	840	µg/L	<50-160	--	1,100	--	No

* Chemicals without an RBSL or ARAR are considered chemicals of potential concern and are discussed in the Final Oliktok Point Risk Assessment, Section 2.1.5 (U.S. Air Force 1996).
NA Not analyzed.
a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.
d TSCA cleanup level.
e EPA 1991c.
f MCL, 56 FR 3526 (30 January 1991).
g MCL, 52 FR 25690 (08 July 1987).
h MCL, 56 FR 30266 (01 January 1991).
i MCL, 56 FR 26460 (07 June 1991).
j The concentrations reported for metals in surface water are total metals.
J Result is an estimate.

5.0 FEASIBILITY STUDY

The purpose of this section is to present the FS of remedial alternatives for the sites at Oliktok Point radar installation recommended for remedial action. These sites were identified based on the findings of the RI, reported in Sections 1.0 through 4.0 of this document, and the Oliktok Point Risk Assessment (U.S. Air Force 1996). The Oliktok Point sites recommended for remedial action and covered by this FS are:

- Diesel Spill (SS05);
- Gasoline Storage Area (ST08);
- Garage (SS10); and
- Old Sewage Area Petroleum Area (SS11).

Complete RI results for these sites are presented in Section 4.0. This FS describes the evaluation of remedial alternatives used as the basis for the selection of the proposed remedial actions for the sites listed above.

Sites requiring no further action based on the RI and risk assessment are not included in this section. The proposed no further action sites are the Old Landfill (LF01), Dump Site (LF02), Dock Storage Area (ST03), and POL Storage (ST04). RI results for these sites are presented in Section 3.0.

This FS complies with the NCP. It has been streamlined as described in the following section. The remainder of the introduction consists of a discussion of the streamlining approach, including risk management decisions, and an outline of the organization of the FS.

5.0.1 Approach To Feasibility Study

This FS is streamlined as follows to minimize unnecessary evaluation of remedial alternatives for the sites at Oliktok Point.

- Remedial alternatives are developed for contaminated media (gravel, tundra, and soil beneath buildings), instead of individual sites. It is more logical, for instance, to remediate all of the gravel at the installation rather than conduct separate remedial actions at the three sites that have contaminated gravel.

- Remedial action characterization tables (presented in Section 5.1) recommended in the AFCEE Handbook (U.S. Air Force 1991) have been adapted to focus on the data essential to the evaluation of remedial alternatives. Wherever possible, reference is made to the RI and risk assessment for detailed site information, and assumptions used in calculating risk and identifying COCs to minimize repetition.

- General response actions (GRAs) and applicable technologies are screened together, and the alternatives are limited to no more than five conventional and innovative methods including the required no action alternative.

- Because of the lack of extensive remedial activity on the North Slope, the notion of "proven" is sometimes an extrapolation from existing case studies. As a result, there is more uncertainty associated with remedial actions in the harsh climate of the North Slope than elsewhere. Preferred alternatives, therefore, are presented in general terms, and include provisions for treatability testing. This approach also allows for more flexibility in decision making in the event that new and better remedial alternatives become available at the time remedial action begins.

5.0.2 Risk Management Decisions

Three risk management decisions were made in writing the FS, based on a thorough review of the data.

- Remedial alternatives do not address Aroclor 1254 in soil beneath the Garage (SS10) because its residual risk is very small relative to the petroleum hydrocarbons. To include Aroclor 1254 would unnecessarily increase the cost of potential remedial alternatives and eliminate several viable alternatives for petroleum hydrocarbon contamination. In addition, PCBs (Aroclor 1254) were only detected in 1 of 14 soil/sediment samples collected at the site at a concentration of 3 mg/kg.

- The surface water associated with the Old Sewage Area Petroleum Spill (SS11) contains several inorganic COCs, including manganese, lead, copper, barium, and vanadium. Of these, manganese is the predominant source of potential hazard. The remedial alternatives for this site are designed to treat or remove petroleum hydrocarbons from the soil. In so doing, the remedial alternatives will indirectly reduce the levels of manganese in surface water through precipitation of an oxide of manganese. The presence of petroleum hydrocarbons creates a reducing environment in which naturally occurring manganese can be converted to the mobile $^{-}6$ oxidation state. With the removal of the petroleum hydrocarbons from the soil, the concentration of petroleum hydrocarbons in surface water will decrease. This, in turn, results in a more oxidizing environment in which soluble manganese ($^{-}6$) can be precipitated as $Mn(^{-}4)O_2$ (pyrolusite), a common, insoluble mineral. The residual risk or hazard associated with the remaining metals is very small; therefore, in this case, the remediation of petroleum hydrocarbons and manganese is sufficient to protect human health and the environment.

- Water in tundra areas has been affected by contamination at the installation. Methods for remediating water directly are not promising because the surface water is extremely shallow, covers a wide area, remains frozen for over half the year, and is intimately associated with tundra. ADEC recognizes that physical remedial actions can be more harmful to tundra than petroleum contamination (see the Interim Guidance for Non-UST Contaminated Soil Cleanup Levels, Guidance Number 001 - Revision Number 1, July 17, 1991, page 10). Instead of evaluating direct remedial alternatives for water in otherwise natural tundra areas, the approach has been taken that remediation of the source will improve the

quality of surface water over time for petroleum hydrocarbons. For other COCs (e.g., tetrachloroethene) this residual risk is small compared to that posed by the petroleum hydrocarbons. The strategy of removal or treatment of petroleum hydrocarbons will, based on the risk assessment, result in sites passing acceptable risk or hazard to human health and the environment. The preferred remedial alternatives include a provision for sampling surface water to confirm the effectiveness of remedial actions.

As a result of these risk management decisions, the focus of the FS is on the cleanup of the sources of contamination in soil and gravel at the Oliktok Point installation. The primary COC in site soils and gravel at the installation is DRPH. Other COCs include GRPH, RRPH, benzene, PCBs, tetrachloroethene, and (bis 2-ethylhexyl)phthalate (a plasticizer and common lab contaminant).

5.0.3 Organization

The FS is organized as follows:

- Introduction;
- Site characterization for remediation (considers COCs, ranges of chemicals detected, estimated areas and volumes of affected media, ARARs, and target cleanup levels or proposed remediation goals for each site);
- Screening of GRAs and presentation of representative remedial technologies;
- Development of remedial alternatives;
- Detailed evaluation of remedial alternatives (the detailed analysis is based on the AFCEE guidance and includes analyses of the nine NCP criteria). The detailed evaluation also includes a comparative analysis of alternatives, and identification of preferred alternatives);
- Siting study; and
- Detailed cost estimates and estimates of project duration in Attachments A and B, respectively.

5.1 SITE CHARACTERIZATION FOR REMEDIATION

Information relevant to the screening and evaluation of remedial alternatives for the four sites at Oliktok Point is summarized in Tables 5-1 through 5-4. The tables include COCs, concentrations of chemicals detected, estimates of volumes of affected media, and the basis for listing each as a COC.

TABLE 5-1. REMEDIAL ACTION CHARACTERIZATION FOR THE DIESEL SPILL (SS05)

MEDIA	COCs	RANGE OF ENVIRONMENTAL CONTAMINATION (mg/kg)	TARGET CLEANUP LEVEL[a] (mg/kg)	BASIS FOR LISTING AS COC	VOLUME OF CONTAMINATED MEDIA (CY)	DESIGN PARAMETERS
Gravel	DRPH	1,610 - 3,210	500	ADEC Non-UST Action Level	237	• microbial activity • oxygen diffusion • moisture • contaminant • concentration • solubility • volume • grain sizes • seasonality • volatility • drainage
	GRPH	213 - 422	100	ADEC Non-UST Action Level		
Tundra	DRPH	ND - 17,300	500	ADEC Non-UST Action Level	1,110	
	GRPH	ND - 134	100	ADEC Non-UST Action Level		

[a] Target cleanup levels for DRPH and GRPH in soil are based on ADEC Non-UST guidance and do not necessarily correspond to final site-specific cleanup goals.

TABLE 5-2. REMEDIAL ACTION CHARACTERIZATION FOR THE GASOLINE STORAGE AREA (ST08)

MEDIA	COCs	RANGE OF ENVIRONMENTAL CONTAMINATION (mg/kg)	TARGET CLEANUP LEVEL[a] (mg/kg)	BASIS FOR LISTING AS COC	VOLUME OF CONTAMINATED MEDIA (CY)	DESIGN PARAMETERS
Gravel	DRPH	35,700 - 61,500	500	ADEC Non-UST Action Level	1,480	• microbial activity • oxygen diffusion • moisture • contaminant • concentration • solubility • volume • grain sizes • seasonality • volatility • drainage
	GRPH	750 - 1,700	100	ADEC Non-UST Action Level		
Tundra	DRPH	690 - 300,000	500	ADEC Non-UST Action Level	2,965	
	GRPH	94 - 2,200	100	ADEC Non-UST Action Level		
	RRPH	ND - 15,000	2,000	ADEC Non-UST Action Level		
	Benzene	ND - 12.9	0.5	ADEC Non-UST Action Level		

[a] Target cleanup levels for DRPH, GRPH, RRPH, and BTEX in soil are based on ADEC Non-UST guidance and do not necessarily correspond to final site-specific cleanup goals.

TABLE 5-3. REMEDIAL ACTION CHARACTERIZATION FOR THE GARAGE (SS10)

MEDIA	COCs	RANGE OF ENVIRONMENTAL CONTAMINATION (mg/kg)	TARGET CLEANUP LEVEL[a] (mg/kg)	BASIS FOR LISTING AS COC	VOLUME OF CONTAMINATED MEDIA (CY)	DESIGN PARAMETERS
Gravel[b]	DRPH	2,100 (only one sample)	500	ADEC Non-UST Action Level	3,335	• microbial activity • oxygen diffusion • moisture • contaminant • concentration • solubility • volume • grain sizes • seasonality
	GRPH	1,200 (only one sample)	100	ADEC Non-UST Action Level		
Tundra	DRPH	ND - 35,600	500	ADEC Non-UST Action Level	222	• buffering capacity • drainage
	GRPH	ND - 1,300	100	ADEC Non-UST Action Level		
Soil Beneath the Garage	DRPH	5,400 - 75,000	500	ADEC Non-UST Action Level	370	• microbial activity • temperature • vertical clearance • contaminant • concentration • solubility • drainage • accessibility
	GRPH	ND - 1,500	100	ADEC Non-UST Action Level		
	RRPH	50,000 - 52,000	2,000	ADEC Non-UST Action Level		
	Benzene	ND - 3.5	0.5	ADEC Non-UST Action Level		
	Aroclor 1254[c]	ND - 3	<10[c]	> RBSL[d]		

a Target cleanup levels for DRPH, GRPH, RRPH, and benzene in soil are based on ADEC Non-UST guidance and do not necessarily correspond to final site-specific cleanup goals.
b Only one gravel sample was collected at this site. Additional samples were collected from this gravel pad during sampling of the adjoining Gasoline Storage Area (ST08).
c The risk assessment identifies carcinogenic COCs based on an excess cancer risk of 10^{-6}. EPA does not generally require cleanup under Superfund of carcinogenic COCs until the excess cancer risk is 1×10^{-4} or greater. The concentration of Aroclor 1254 that corresponds to an excess cancer risk of 1×10^{-4} is > 10 mg/kg. The maximum concentration of Aroclor 1254 detected at the Garage (SS10) is 3 mg/kg (cancer risk of 4×10^{-6}). Final site-specific cleanup goals will require negotiation based on ADEC regulations and guidance, Toxics Substances Control Act requirements, and excess cancer risk.
d Risk based screening level.

TABLE 5-4. REMEDIAL ACTION CHARACTERIZATION FOR THE OLD SEWAGE AREA PETROLEUM SPILL (SS11)

MEDIA	COCs	RANGE OF ENVIRONMENTAL CONTAMINATION (mg/kg)	TARGET CLEANUP LEVEL[a] (mg/kg)	BASIS FOR LISTING AS COC	VOLUME OF CONTAMINATED MEDIA (CY)	DESIGN PARAMETERS
Tundra	DRPH	15.5 - 4,700	500	ADEC Non-UST Action Level	740	• microbial activity • oxygen diffusion • contaminant • concentration • buffering capacity • solubility • drainage
	GRPH	ND - 389	100	ADEC Non-UST Action Level		

[a] Target cleanup levels for DRPH and GRPH in soil are based on ADEC Non-UST guidance and do not necessarily correspond to final site-specific cleanup goals.

5.1.1 Summary of Site Information

The information considered for each medium includes:

- COCs;
- Range of COCs detected;
- Target cleanup level (or proposed remediation goal - the lowest applicable action level, based on the risk assessment including cancer risk, noncancer HQ, and based on chemical-specific ARARs);
- Basis for the target cleanup level (chemical-specific ARAR, cancer risk or noncancer HQ); and
- Design parameters for remedial action.

5.1.2 Estimated Areas, Volumes, and Masses of Contaminated Sites and Media

The approximate areas, volumes, and mass of the contaminated sites by medium are presented in Table 5-5. Areas and depths are estimated based on the RI, and the density of soil and gravel is estimated to be 1.8 tons/cubic yard. Actual areas, densities, and depths of contamination may differ from the estimates, which will affect the cost of remediation. The locations and estimated volumes of contaminated media are illustrated in Figures 5-1 through 5-4. The estimated total volume of each is:

- Gravel - 5,052 cubic yards;
- Tundra - 5,037 cubic yards; and
- Soil beneath the Garage (SS10) - 370 cubic yards.

GRAs and remedial alternatives are screened and evaluated for each medium.

Estimates of cost and project duration are provided in Attachments A and B, respectively. These attachments are located at the end of Section 5.0.

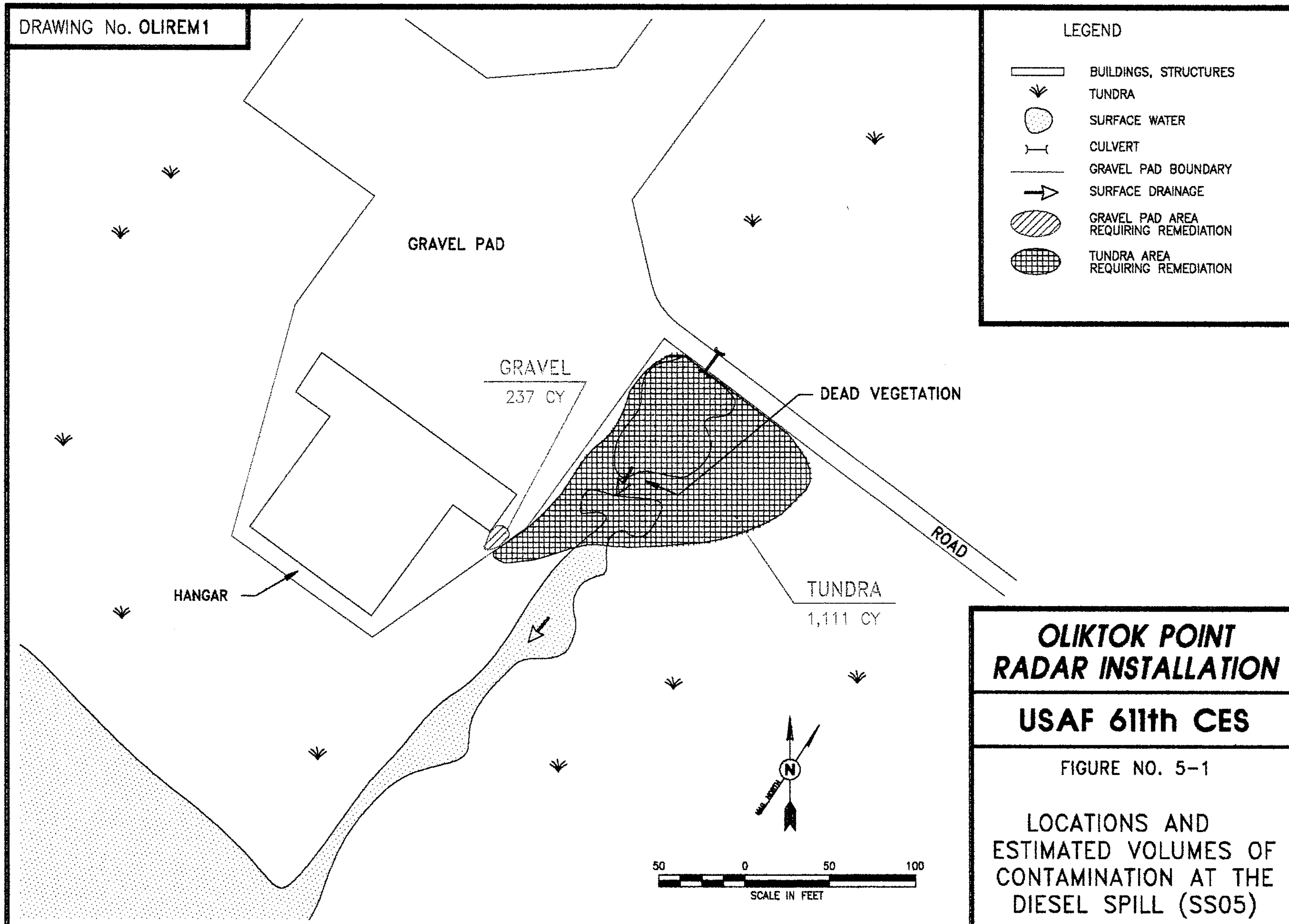
5.1.3 ARARs

According to the NCP, ARARs must be identified and evaluated to determine all of the requirements for remedial actions. There are three categories of ARARs:

- Chemical-specific;
- Action-specific; and
- Location-specific.

Chemical-specific ARARs are action levels that may apply in addition to risk or hazard-based remediation goals. Chemical-specific ARARs were identified during the RI and included in the risk assessment. The target cleanup levels or proposed remediation goals represent the lowest applicable action level.

DRAWING No. OLIREM1



OLIKTOK POINT RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 5-1

LOCATIONS AND ESTIMATED VOLUMES OF CONTAMINATION AT THE DIESEL SPILL (SS05)

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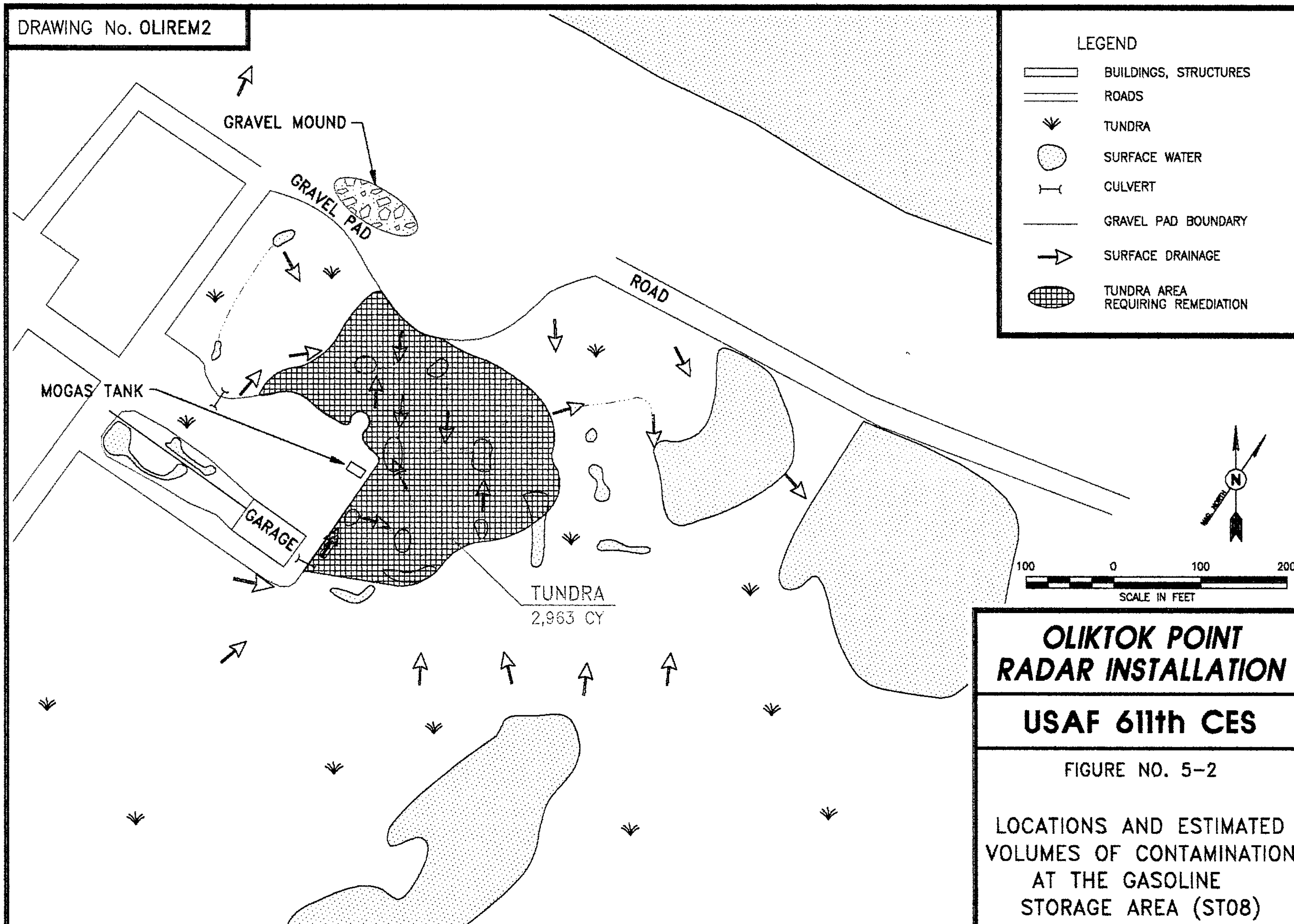
DRAWING No. OLIREM2



OLIKTOK POINT RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 5-2

LOCATIONS AND ESTIMATED VOLUMES OF CONTAMINATION AT THE GASOLINE STORAGE AREA (ST08)

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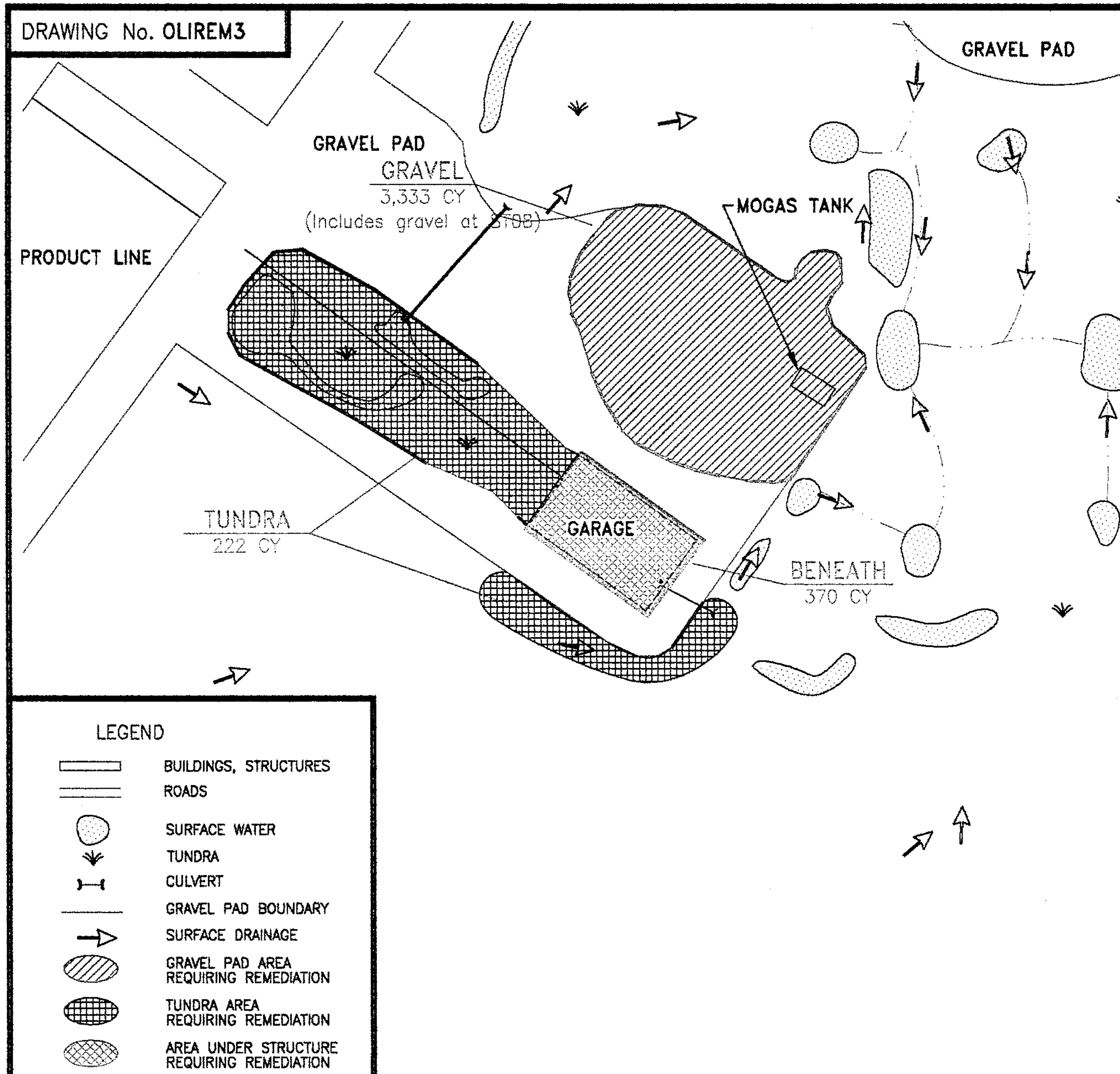

OLIKTOK POINT RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 5-3

LOCATIONS AND ESTIMATED VOLUMES OF CONTAMINATION AT THE GARAGE (SS10)

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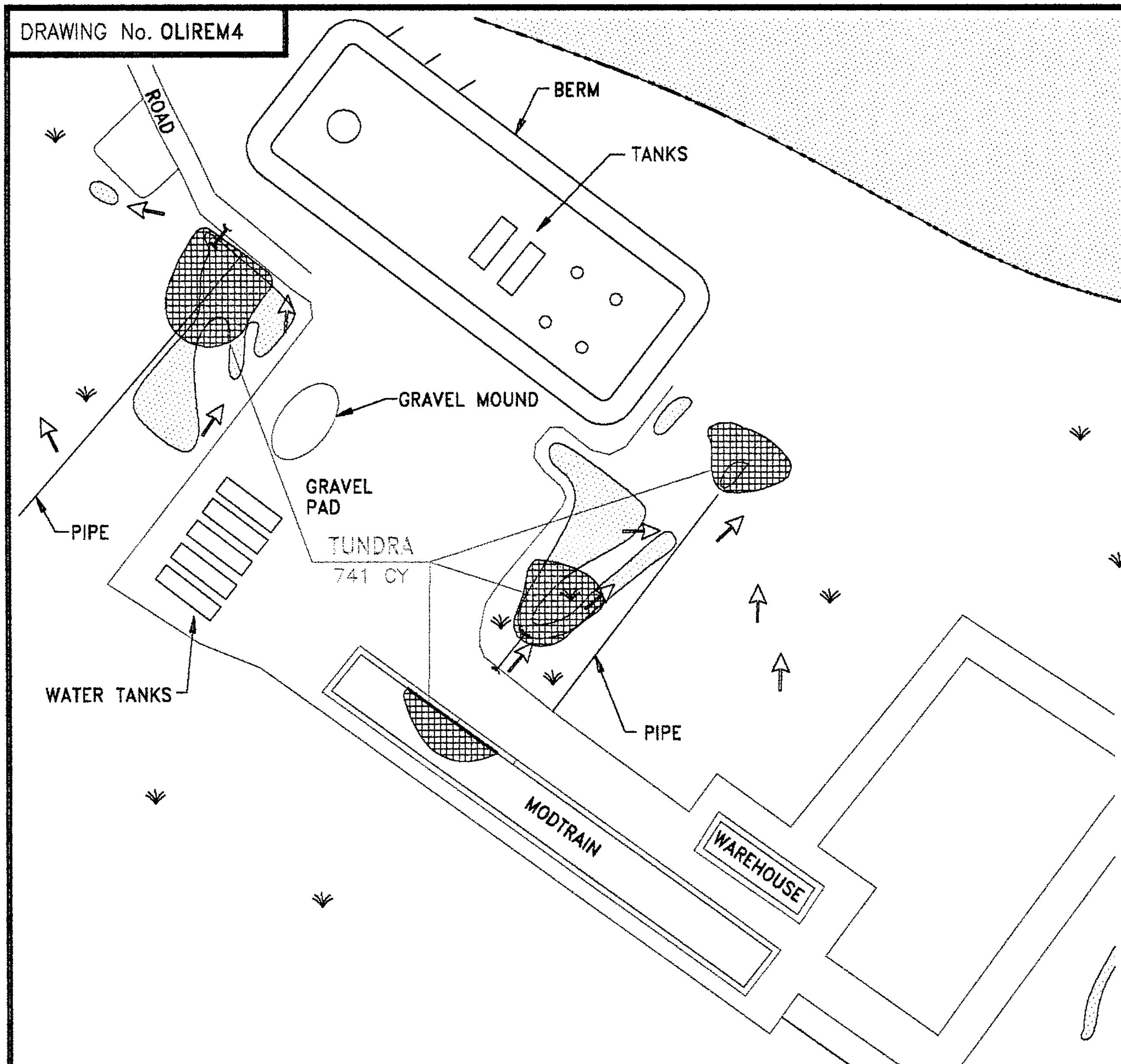
DRAWING No. OLIREM4



LEGEND

BUILDINGS, STRUCTURES
ROADS
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
TUNDRA AREA REQUIRING REMEDIATION

50 0 50 100 150
SCALE IN FEET

OLIKTOK POINT RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 5–4

LOCATIONS AND ESTIMATED VOLUMES OF CONTAMINATION AT THE OLD SEWAGE AREA PETROLEUM SPILL (SS11)

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TABLE 5-5. APPROXIMATE AREAS, VOLUMES AND MASSES OF CONTAMINATED MEDIA BY SITE AT OLIKTOK POINT

SITE	MEDIUM	AREA (sq ft)	DEPTH (ft)	VOLUME (cy)	MASS (tons)
Diesel Spill (SS05)	Gravel	1,600	4	237	427
	Tundra	15,000	2	1,110	2,000
Gasoline Storage Area (ST08)	Gravel	10,000	4	1,480	2,670
	Tundra	40,000	2	2,965	5,330
Garage (SS10)	Gravel	22,500	4	3,335	6,000
	Tundra	3,000	2	222	400
	Soil beneath the garage	5,000	2	370	665
Old Sewage Area Petroleum Spill (SS11)	Tundra	10,000	2	740	1,330

Action-specific ARARs are requirements that relate to how remedial actions must be conducted. For example, offsite transportation of hazardous waste must be manifested in compliance with Department of Transportation (DOT) and RCRA requirements.

Location-specific ARARs impose requirements on a remedial action based on the location of the site. For example, there are specific requirements that pertain to wetlands. It should be noted that ADEC's Interim Guidance Non-UST contaminated soil target cleanup levels are intended as guidance and do not necessarily correspond to final site-specific cleanup levels. The ARARs for the sites at the Oliktok Point installation are presented in Table 5-6.

5.2 SCREENING OF GENERAL RESPONSE ACTIONS

5.2.1 Presentation and Screening of General Response Actions

GRAs are general approaches for remedial actions and can be active or passive measures. Active measures involve removal, active treatment, or isolation of the contaminated media. Passive measures rely on natural processes to reduce the toxicity, mobility or volume of contamination, or on controls put in place to limit exposure. Screening GRAs streamlines the FS process by establishing the feasibility of entire classes of remedial responses, thereby enabling the selection of a focused set of viable alternatives for detailed evaluation. GRAs have been evaluated for the media contaminated at the Diesel Spill (SS05), Gasoline Storage Area (ST08), Garage (SS10), and the Old Sewage Area Petroleum Spill (SS11). It is most likely that any remedial action at Oliktok Point would be focused on the individual media rather than the sites. For example, alternatives for all of the gravel pad areas are more likely to be undertaken than

TABLE 5-6. ARARs FOR SITES AT THE OLIKTOK POINT INSTALLATION

AUTHORITY	CITATION	TYPE OF ARAR	BASIS	CATEGORY OF ARAR
RCRA	40 CFR Part 263	Action-specific	Standards Applicable to Generators of Hazardous Waste	Relevant and Appropriate
RCRA	40 CFR 268.35	Action-specific	Land Disposal Restrictions	Relevant and Appropriate
Clean Air Act	42 U.S.C. 7401-7642, 40 CFR 60, 61, and 63	Action-specific	National Ambient Air Quality Standards (Treatment technology standards for fugitive emissions and landfills)	Applicable
RCRA	55 FR 30798	Chemical-specific	Standard for Solid Waste Management Units, SWMUs, in the RCRA Corrective Action Program	Relevant and Appropriate
SDWA	52 FR 25690 56 FR 3526	Chemical-specific	Maximum Contaminant Level for drinking water	Relevant and Appropriate
ADEC, Interim Guidance for Non-UST Action Levels	18 AAC 75.140	Chemical-specific	Standards for general guidance	Relevant and Appropriate
ADEC, Solid Waste Disposal Regulations	18 AAC 60	Action-specific	Standards applicable to land spreading	Applicable
Toxic Substances Control Act	40 CFR 761.60(a)(4)	Action-specific	PCB disposal requirements	Applicable

those for sites with small volumes of tundra and gravel pad. The screening of GRAs, and the development and evaluation of remedial alternatives, therefore, is based on a medium-specific approach.

The criteria for screening GRAs are implementability, duration, effectiveness, and cost. Implementability is estimated in terms of technical and administrative barriers. For example, containment is generally less acceptable to regulatory agencies than removal or treatment. Additionally, an innovative technology that has proven to be effective in the continental U.S. may not be implementable on the North Slope because it cannot be transported there.

Duration is the estimate of the time necessary to attain the treatment efficiency estimated from applicable case studies and the literature. The estimated duration of no action where it includes natural, unassisted biodegradation is long even though the time necessary to implement no action is short.

Effectiveness is the relative success of the response action in reducing contamination or risk to acceptable levels.

Cost is the estimated capital, operating, and administrative costs necessary to attain the projected treatment efficiency. This estimate is presented in relative terms (low, medium, and high).

The GRAs considered for the four sites at Oliktok Point are:

- No action;
- Institutional controls and monitoring;
- Containment;
- Onsite treatment; and
- Removal.

These GRAs are defined as follows.

No Action. Under no action, contaminants are left in place and only natural processes, such as biodegradation, would lower the concentrations of COCs. No action is considered for all three media.

Institutional Controls and Monitoring. Institutional controls and monitoring represent a passive response in which steps are taken to minimize the possibility of accidental exposure of humans and the environment to COCs. Institutional controls may include fencing off an area to minimize exposure and public education to show people how to avoid exposure. Institutional control of sites contaminated by petroleum hydrocarbons minimizes the chance of accidental exposure while natural, unassisted biodegradation occurs. Monitoring is included to determine if migration of contaminants is occurring and if natural processes are lowering the concentrations of the COCs.

Containment. Containment limits the potential for accidental exposure to contaminants by physical means. Examples include capping soils and using solidification techniques including the maintenance of freezing conditions. Objectives can include one or more of the following: 1) minimize the risk of direct exposure to contaminated soils; 2) eliminate the possibility of contaminants or contaminated soils becoming airborne and migrating; and 3) prevent water from entering the contaminated area and transporting contaminants to other areas.

Onsite Treatment. Treatment may be used to reduce the toxicity, mobility, or volume of a contaminant and may be accomplished in situ or ex situ. In situ treatment involves active treatment with the medium in place. Ex situ treatment involves the removal of the contaminated medium, with subsequent treatment on the installation. The medium may be replaced in the original excavation after treatment or, as in the case of successful land spreading, be left where treatment took place. Treatment efficiencies vary depending on the technique used and the type of contaminant present.

Removal. Removal includes excavating the contaminated medium and shipping it offsite for treatment or disposal. Removal reduces the risk of exposure to the contaminant because it no longer remains at the installation.

Representative technologies for the GRAs retained are presented and screened in Section 5.2.2.

GRAs considered for remediation of gravel, tundra, and the soil beneath the garage at the four sites slated for remediation at Oliktok Point are presented in Tables 5-7 through 5-9. Screening was performed as follows:

5.2.1.1 Screening of GRAs for Contaminated Gravel. GRAs considered for remediation of gravel are presented in Table 5-7. No action, institutional controls and monitoring, and onsite treatment were retained for evaluation.

5.2.1.2 Screening of GRAs for Contaminated Tundra. GRAs considered for remediation of tundra are presented in Table 5-8. No action, institutional controls and monitoring, and onsite treatment were retained for evaluation.

5.2.1.3 Screening of GRAs for Soil Beneath The Garage. GRAs considered for remediation of soil beneath the Garage (SS10) are presented in Table 5-9. No action, containment, and onsite treatment were retained for evaluation.

5.2.2 Presentation of Technologies

This section describes remedial technologies considered for use at Oliktok Point based on the retained GRAs. The selected technologies have all been effective in the Alaskan environment. The conditions present at Oliktok Point, principally the arctic climate and remote location, exclude many technologies that could be considered for sites in a more temperate and accessible location.

TABLE 5-7. SCREENING OF GENERAL RESPONSE ACTIONS EVALUATED FOR GRAVEL

GENERAL RESPONSE ACTION	REPRESENTATIVE TECHNOLOGIES	PROJECTED TREATMENT EFFICIENCY	RETAINED OR REJECTED	RATIONALE
No action	• No action	50 percent	Retained	Implementability: Moderate Duration: Short in the field, long to achieve biodegradation. Effectiveness: Low to Moderate Cost: Low Retained/Rejected: Retained (requirement of NCP).
Institutional controls and monitoring	• Institutional controls (monitoring, public education, fencing)	50 percent	Retained	Implementability: High Duration: Moderate in the field, long to achieve biodegradation. Effectiveness: Low to Moderate Cost: Low Retained/Rejected: Retained due to high implementability and low cost.
Containment	• Solidification • Capping	80 percent reduction in mobility 0 percent reduction in mass	Rejected	Implementability: Low Duration: Long Effectiveness: Low Cost: Moderate Retained/Rejected: Rejected due to low implementability, low effectiveness, and long duration.
Onsite treatment	• Enhanced bioremediation • Land spreading	75 - 94 percent	Retained	Implementability: High Duration: Short to Moderate Effectiveness: Moderate to High Cost: Moderate Retained/Rejected: Retained due to high implementability, moderate to high effectiveness, and short to moderate duration.
Removal	• Offsite treatment/disposal	100 percent	Rejected	Implementability: Moderate to High Duration: Short Effectiveness: High Cost: High Retained/Rejected: Rejected due to high cost.

TABLE 5-8. SCREENING OF GENERAL RESPONSE ACTIONS EVALUATED FOR TUNDRA

GENERAL RESPONSE ACTION	REPRESENTATIVE TECHNOLOGIES	PROJECTED TREATMENT EFFICIENCY	RETAINED OR REJECTED	RATIONALE
No action	• No action	50 percent	Retained	Implementability: Moderate Duration: Short in the field, long to achieve biodegradation. Effectiveness: Low to Moderate Cost: Low Retained/Rejected: Retained (requirement of NCP).
Institutional controls and monitoring	• Institutional controls and monitoring (monitoring, public education, fencing)	50 percent	Retained	Implementability: High Duration: Moderate in the field, long to achieve biodegradation. Effectiveness: Low to Moderate Cost: Low Retained/Rejected: Retained due to high implementability and low cost.
Containment	• Solidification • Capping	80 percent reduction in mobility 0 percent reduction in mass	Rejected	Implementability: Low Duration: Long Effectiveness: Low Cost: Moderate Retained/Rejected: Rejected due to low implementability, low effectiveness, and long duration.
Onsite treatment	• Enhanced bioremediation	75 - 94 percent	Retained	Implementability: High Duration: Short to Moderate Effectiveness: Moderate to High Cost: Moderate Retained/Rejected: Retained due to high implementability, moderate to high effectiveness, and short to moderate duration.
Removal	• Offsite treatment/disposal	100 percent	Rejected	Implementability: High Duration: Short Effectiveness: High Cost: High Retained/Rejected: Rejected due to high cost.

TABLE 5-9. SCREENING OF GENERAL RESPONSE ACTIONS EVALUATED FOR SOIL BENEATH THE GARAGE

GENERAL RESPONSE ACTION	REPRESENTATIVE TECHNOLOGIES	PROJECTED TREATMENT EFFICIENCY	RETAINED OR REJECTED	RATIONALE
No action	• No action	50 percent	Retained	Implementability: Moderate Duration: Short in the field, long to achieve biodegradation. Effectiveness: Low to Moderate Cost: Low Retained/Rejected: Retained (requirement of NCP).
Institutional controls and monitoring	• Institutional controls and monitoring (monitoring, public education, fencing)	50 percent	Retained	Implementability: High Duration: Moderate in the field, long to achieve biodegradation. Effectiveness: Low to Moderate Cost: Low Retained/Rejected: Retained due to high implementability and low cost.
Containment	• Containment by maintenance of freezing conditions	90 percent reduction in mobility 0 percent reduction in mass	Retained	Implementability: Moderate Duration: Long Effectiveness: High Cost: Low to Moderate Retained/Rejected: Retained due to moderate implementability, high effectiveness, and low to moderate cost.
Onsite treatment	• Enhanced bioremediation • Biosurfactants	75 - 94 percent	Retained	Implementability: High Duration: Short to Moderate Effectiveness: Moderate to High Cost: Moderate Retained/Rejected: Retained due to high implementability, moderate to high effectiveness, and short to moderate duration.
Removal	• Offsite treatment/disposal	100 percent	Rejected	Implementability: Low Duration: Short Effectiveness: High Cost: High Retained/Rejected: Rejected due to low implementability and high cost.

The remedial technologies under consideration for the contaminated media at Oliktok Point are presented in this section by GRA as follows:

No Action

- No action

Institutional Controls and Monitoring

- Institutional controls and management (periodic monitoring, public education, fencing)

Containment

- Containment by maintenance of freezing conditions (containment)

Onsite Treatment

- Enhanced bioremediation
- Land spreading
- Biosurfactants

All of the technologies presented above have been applied effectively at sites on the North Slope or elsewhere in Alaska. In addition to being effective in cold climates, they are well-suited to the short summer season (the only favorable time for outdoor remedial activities) and the remote location where there is little or no staffing for year-round operation and maintenance of remedial systems. Specifically, these remedial technologies are either short-term actions that can be completed in one season (approximately 100 days) with imported labor, or longer term actions that are self-sustaining and require minimal labor.

Several of the retained remedial technologies involve bioremediation, which may be accomplished on the North Slope with psychrophilic (i.e., cold weather) microorganisms both indigenous and imported. Bioremediation has been documented on the North Slope and elsewhere in Alaska, but is subject to several limiting factors including:

- Availability of nutrients and oxygen;
- Short periods of thaw; and
- Percentage of fine-grained materials.

Biodegradation generally can be estimated in terms of first order kinetics where the only rate limiting factor is the biodegradation potential. Biodegradation potential is a function of the factors listed above. With first order kinetics, a given target cleanup level will eventually be reached regardless of the initial concentration. As the gap between initial and target concentrations widens or rate limiting factors become more significant, however, the time necessary to reach the target increases exponentially because the function plots asymptotically with concentration. A more detailed discussion of the estimates of biodegradation is presented in Section 5.4.

Descriptions of the technologies that have been retained are presented in the following subsections.

5.2.2.1 No Action. No action is a required alternative of the NCP, the purpose of which is to provide a baseline for assessment of other alternatives.

5.2.2.2 Institutional Controls and Monitoring. This technology involves no active treatment, but takes advantage of natural, unassisted biodegradation that occurs in the arctic soil (Atlas 1985). Natural, unassisted bioremediation typically takes longer than assisted bioremediation. The rate of biodegradation, especially in the North Slope region, is reduced because of short warm seasons and prolonged harsh winters. Public education and fencing off the affected area would constitute institutional controls, and periodic monitoring would include sampling and analysis of any associated surface water and soil/sediment.

Institutional controls and monitoring are being evaluated for the petroleum-related contaminants in gravel, tundra, and soil beneath the Garage (SS10) at Oliktok Point. The case studies used to support biodegradation-based alternatives are used to estimate potential rates of natural, unassisted bioremediation.

5.2.2.3 Containment by Maintenance of Freezing Conditions (Containment). The contaminated soil beneath the Garage (SS10) represents a difficult remedial problem because the Air Force does not intend to raze the structure at this time. The vertical access is insufficient to manually remove the contaminated soil or to use equipment to do so. Attempts to flush the contamination introduce issues related to the control of runoff and the potential loss of structural integrity of the piles on which the Garage rests due to melting of permafrost. The latter may not be the primary concern because the piles are set very deeply. One solution is to maintain freezing conditions under the building year round to keep contaminants locked in ice or frozen ground. The underside of the Garage is already quite cold because it remains shaded during the summer. Examples of cold containment include insulation, gravel cover, and heat exchangers. Once the building is dismantled, the contaminated soil can be excavated and managed appropriately.

5.2.2.4 Enhanced Bioremediation. Enhanced bioremediation in this FS involves delivering water and nutrients to the contaminated soils in place to assist natural bioremediation. Several organisms that can utilize the carbon in petroleum are indigenous to the North Slope, including: *Bacillus cereus, Bacillus polymixa, Arthrobacter globiformis*, and *Alcaligenes poradoxus* (Ratliff 1993). In addition, several strains of *Pseudomonas* bacteria (psychrophilic genera) decreased TPH concentration in tundra during the summer season in the Prudhoe Bay area (Jorgenson et al. 1992). A case study conducted at Point Thompson, Alaska suggests that this approach is feasible for remediation of gravel pads if a cultured population of microbes is used (Liddell et al. 1991). The cultured population could be either indigenous or exotic. A treatability study will be necessary to determine how best to bioremediate each of the three media.

Variations in temperature affect the rate of biodegradation by bacteria. In the arctic environment, bacteria remain active enough to consume petroleum hydrocarbon molecules from June through

August when temperatures are warmest. Successful biodegradation of petroleum hydrocarbon contaminants in soil by indigenous bacteria is possible at the ambient arctic summer temperatures. A study at Surfcote Pad in the Prudhoe Bay area (Evans, Elder, and Hoffman 1992) indicates that native microbial populations were capable of bioremediating diesel contaminated gravel at an appreciable rate during the short summer season. In the arctic environment at a depth of three feet microbial populations can effectively consume hydrocarbon products (Atlas 1985). The number and activity of bacteria decrease with depth however, because of reduced levels of oxygen and nutrients.

Enhanced bioremediation is being evaluated for gravel, the soil beneath the Garage (SS10), and tundra. Water with microbes and nutrients may be added intermittently based on the results of a treatability study. It is anticipated that this process would not generate runoff. Nonetheless, precautions will be taken to contain any runoff that occurs. Any collected runoff would be analyzed for COCs. Figure 5-5 is a process flow diagram of enhanced bioremediation.

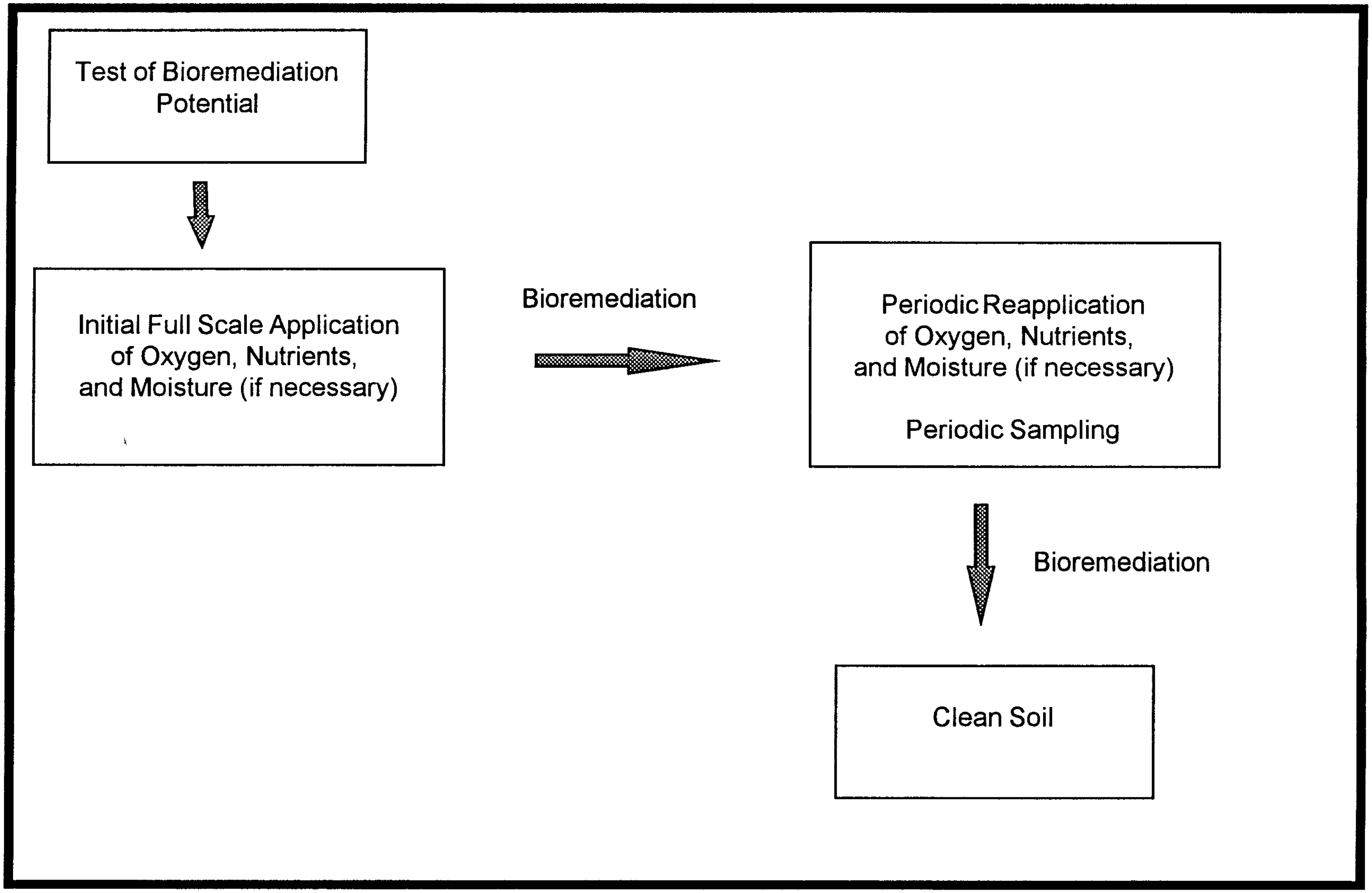
5.2.2.5 Biosurfactants. Biosurfactants have been used to remove hydrocarbons from contaminated soils and gravels. Biosurfactants are products of bacterial fermentation and may include sugars, fats, and proteins. They act by attaching to, and surrounding, hydrocarbon molecules thus detaching them from soil particles. Biosurfactants do not alter the structure of the hydrocarbons, but render them temporarily inert, preventing them from reattaching to soil particles and allowing their removal from soils by flushing with water. The flush water mixture is then collected and the biosurfactant-hydrocarbon mixture, which floats on water, is removed by skimming. The collected mixture of water and petroleum hydrocarbons can be containerized for offsite treatment/disposal or bioremediated onsite in an aerated tank spiked with nutrients.

This technology is being evaluated for treating DRPH, GRPH, RRPH, benzene, and Aroclor 1254 in soil beneath the Garage (SS10). Aroclor 1254 will be removed by this process but disposed of separately because it is assumed to be difficult to biodegrade. Biosurfactant technology is readily available in Alaska and involves using high intensity "air knives" to jet the biosurfactant into the material being remediated. It is anticipated from the results of the site investigations that contamination beneath the structures is shallow (<2 feet) because permafrost close to the surface prevents the hydrocarbons from infiltrating deeply.

After the biosurfactant is applied, the medium will be flushed with water to remove the mix of hydrocarbons and surfactant. The flush water mixture will be collected from drainage pathways exiting areas beneath the Garage (SS10). Performance may not match case histories involving fairly fresh crude oil on rock surfaces, but it is anticipated that the mobile fraction of the weathered petroleum will be dislodged sufficiently for successful remediation. The technique can be tested if necessary at the Garage (SS10) at the location where 75,000 mg/kg of DRPH was detected. Figure 5-6 is a diagram of the process.

5.2.2.6 Land Spreading. The objective of land spreading is to increase the surface area to volume ratio of soils contaminated with petroleum hydrocarbons to allow the low molecular weight fraction to volatilize more quickly, and to enhance biodegradation by exposing more of the soil to air. Target COCs are DRPH and GRPH.

Figure 5-5: Enhanced Bioremediation Process Flow Diagram



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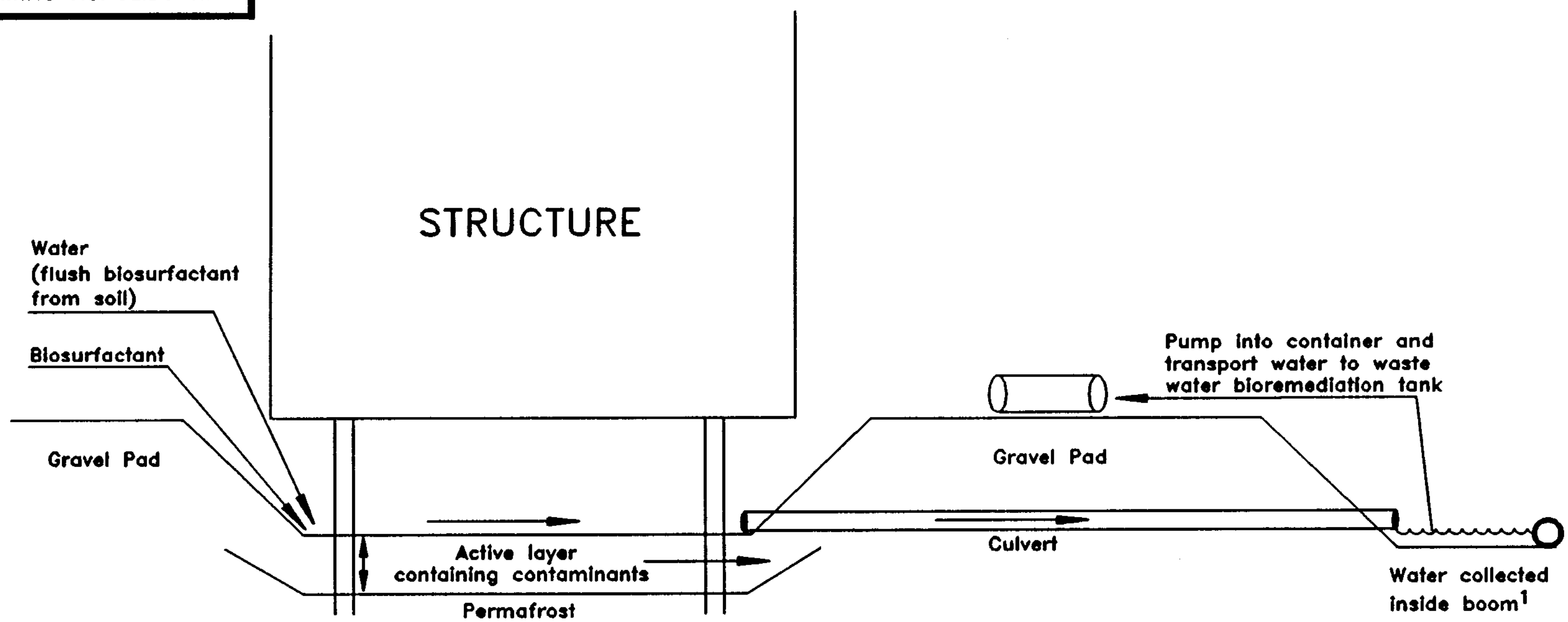

NOTES

This process should begin before general site remediation so that water treated from this process can be used as process water for either soil washing or ex-situ bioremediation.

1. Booms and other collection materials will be tested and disposed of offsite.

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FIGURE NO. 5-6

APPLICATION OF BIOSURFACTANTS PROCESS FLOW DIAGRAM

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Land spreading is being evaluated for the gravel at the Diesel Spill (SS05), Gasoline Storage Area (ST08), and Garage (SS10). The process is straightforward. A backhoe or other earth-moving equipment is used to excavate the contaminated gravel and spread it in two-inch layers on clean gravel. It is important to note that the gravel will not be spread on tundra. Moisture will be added during spreading to promote biodegradation. ADEC regulates this activity under a solid waste disposal permit if the petroleum hydrocarbon contamination exceeds 1,000 mg/kg. The requirement for a solid waste disposal permit will need to be evaluated on a site-by-site basis. Approximately 13.5 acres will be necessary to land spread the contaminated gravel.

$$\left[3{,}626\ yd^3 \ x\ \frac{27\ ft^3}{yd^3}\ x\ \frac{(12\ in/ft)}{2\ in} \div \frac{43{,}560\ ft^2}{acre} \right] = 13.5\ acres$$

There may not be enough area of clean gravel at the installation to land spread the estimated volume of contaminated gravel at one time. Land spreading would therefore have to be staged over several years or permission to employ thicker lifts would have to be obtained.

5.3 DEVELOPMENT OF REMEDIAL ALTERNATIVES

5.3.1 Approach to Developing Remedial Alternatives

The remedial technologies selected in Section 5.2.2 represent the GRAs retained in Section 5.2.1. In this section the remedial technologies are developed into alternatives designed to address site-specific COCs. Because the alternatives are designed around media rather than specific sites, one remedial technology is sufficient to define an alternative that can be applied to different sites. Alternatives developed in this section are evaluated in the detailed evaluation of remedial alternatives, Section 5.4.

This section is organized by remedial alternative. The rationale for development and a list of applicable sites are included. Remedial alternatives are summarized by medium and site in Table 5-10 in Section 5.4.2.

The remedial alternatives retained for contaminated gravel, tundra, and soil beneath the garage are:

<u>Gravel</u>

- No action;
- Institutional controls and monitoring;
- Enhanced bioremediation; and
- Land spreading.

Tundra

- No action;
- Institutional controls and monitoring; and
- Enhanced bioremediation.

Soil Beneath the Garage

- No action;
- Institutional controls and monitoring;
- Containment;
- Enhanced bioremediation; and
- Biosurfactants.

5.3.1.1 No Action.

Rationale for Development. No action provides a baseline against which other alternatives are compared, and it is a required alternative according to the NCP. Attenuation of petroleum hydrocarbons may occur over a long period of time through biodegradation if microbial populations and conditions (e.g., water, oxygen, temperature, and nutrients) are present that facilitate aerobic biodegradation.

Applicable Media and Sites.

- Gravel: Diesel Spill (SS05); Gasoline Storage Area (ST08); and Garage (SS10).
- Tundra: Diesel Spill (SS05); Gasoline Storage Area (ST08), Garage (SS10), and Old Sewage Area Petroleum Spill (SS11).
- Soil beneath the Garage (SS10).

5.3.1.2 Institutional Controls and Monitoring.

Rationale for Development. This alternative is applicable to all of the media because the COCs do not pose a significant cancer risk or noncancer hazard. Attenuation of petroleum hydrocarbons may occur over a long period of time through biodegradation if microbial populations and conditions (e.g., water, oxygen, temperature, and nutrients) are present that facilitate aerobic biodegradation.

Institutional controls considered include public education and fencing off the affected area. Monitoring would be conducted periodically to ensure that contaminants are biodegrading and are not migrating offsite. Monitoring data would be combined with the predicted degradation rate presented in this section to demonstrate the effectiveness of natural, unassisted biodegradation.

Applicable Media and Sites.

- Gravel: Diesel Spill (SS05); Gasoline Storage Area (ST08); and Garage (SS10).
- Tundra: Diesel Spill (SS05); Gasoline Storage Area (ST08), Garage (SS10), and Old Sewage Area Petroleum Spill (SS11).
- Soil beneath Garage (SS10).

5.3.1.3 Containment.

Rationale for Development. The soil beneath the Garage poses several technical problems because the Air Force has no immediate plans to dismantle the building. Vertical access is limited; therefore, conventional excavation is infeasible. Containment by maintenance of freezing conditions could be an effective way to prevent the migration of contaminants until the building is dismantled or a highly effective remedial technology becomes available. Human exposure would be very limited because of the low vertical clearance. Several methods exist for maintaining freezing conditions beneath buildings in Alaska. Methods include insulation, heat exchangers, or a combination of the two.

Applicable Media and Sites.

- Soil Beneath the Garage (SS10).

5.3.1.4 Enhanced Bioremediation.

Rationale for Development. This is an effective, low maintenance method for reducing petroleum concentrations in tundra that is also applicable to gravel and the soil beneath the Garage (SS10). Enhanced bioremediation is accomplished by adding and maintaining nutrients, moisture, and oxygen to the contaminated medium in proportions established through treatability testing that promote the degradation of petroleum hydrocarbons by indigenous microorganisms. This alternative is more aggressive than natural attenuation, yet can be designed to limit disturbance of the tundra and permafrost. A treatability study will be necessary to demonstrate site-specific viability of this alternative. For example, the percentage of fine-grained soils in the gravel will affect its ability to retain moisture and organic carbon.

Periodic monitoring will verify the progress of the process.

Applicable Media and Sites.

- Gravel: Diesel Spill (SS05); Gasoline Storage Area (ST08); and Garage (SS10).
- Tundra: Diesel Spill (SS05); Gasoline Storage Area (ST08), Garage (SS10), and Old Sewage Area Petroleum Spill (SS11).
- Soil beneath Garage (SS10).

5.3.1.5 Biosurfactants.

Rationale for Development. Biosurfactants were proven effective in removing petroleum hydrocarbons from shallow soils, hard surfaces, and rocks following the Valdez oil spill. It is applicable to the soil beneath the Garage (SS10). Biosurfactants are not recommended for the gravel or tundra. This remedial alternative provides a more aggressive solution for the contamination beneath the Garage (SS10).

Rinse water will be monitored in the tank or drums a year after the remedial action to ensure that the petroleum hydrocarbons have biodegraded.

Applicable Media and Sites

- Soil Beneath the Garage (SS10).

5.3.1.6 Land Spreading.

Rationale for Development. Land spreading is a recognized method for remediating petroleum hydrocarbons in gravel in Alaska. There are established regulations for the approach. There may not be 13.5 acres of clean gravel on which to spread the estimated volume of contaminated gravel in two-inch lifts sufficiently far away from surface water. In order to employ land spreading at Oliktok Point, either the project would have to be staged over several years, or thicker lifts would have to be negotiated (i.e., 6 inches). Land spreading is not appropriate for either the tundra or the soil beneath the Garage (SS10). A treatability study will be necessary to demonstrate site-specific viability of this alternative.

Periodic monitoring will establish the effectiveness of this alternative.

Applicable Media and Sites

- Gravel: Diesel Spill (SS05); Gasoline Storage Area (ST08); and Garage (SS10).

5.4 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

5.4.1 Approach

The alternatives developed in Section 5.3 are evaluated in this section using the suggested criteria in the AFCEE guidance for remedial alternative evaluation. These five criteria are defined in Sections 5.4.1.1 through 5.4.1.5. The detailed evaluation of alternatives is conducted in Section 5.4.2 and summarized in Section 5.4.3. The alternatives are evaluated with respect to the NCP's nine criteria in Section 5.4.4. Preferred alternatives are presented in Section 5.4.5.

5.4.1.1 Successful Application Of The Technology Under Site Conditions. This criterion requires the location and approximate date of the applications, the managing entity, and a description of successful applications of the given alternative under conditions similar to those

found at the Oliktok Point installation. Case studies conducted on the Alaskan North Slope are used to the extent possible.

5.4.1.2 Total Project Cost. The total cost of performing the remedial alternative is estimated and divided into technology testing, capital, total labor, operating, environmental testing, and closure costs.

For the purpose of this evaluation, the itemized cost elements are defined as follows:

- Technology testing costs consist of pilot tests or treatability studies;
- Capital costs include equipment or materials purchased;
- Total labor costs include the labor required for operating and maintaining the remedial action system, oversight, project management, design and development of planning documents;
- Operating costs include costs other than labor associated with operating remedial systems (e.g., nutrients);
- Environmental testing costs are for sampling and analysis, including periodic monitoring, and monitoring associated with site closure; and
- Closure costs are those related to reporting associated with site closure.

5.4.1.3 Contaminant Reduction. The reduction in concentration of each COC may be projected for each medium and site based on case-study-derived efficiencies. This reduction, referred to as post-remedial concentration, is listed with the initial concentration and target cleanup level. Post-remedial concentration is a more useful measure of effectiveness than risk reduction for the remedial alternatives at the Oliktok Point installation. None of the COCs present significant cancer risk or noncancer hazard. Risks or hazards, therefore, are not the indicators of successful remediation. Post-remedial concentration is applicable to target cleanup concentrations set by regulations and/or cleanup guidance.

The concentrations presented in this section are defined as follows:

Initial Concentration. This is the average of the maximum concentrations of DRPH detected at the sites. [The average maximum DRPH concentration in gravel = (3,210 + 61,500 + 2,100)/3 = 22,270 mg/kg.]

Target Cleanup Level. This is the cleanup level specified for the given COC (the basis for which is presented in Tables 5-1 through 5-4).

Post Remedial Concentration. This is the estimated final concentration of the COC based on remedial efficiencies from case studies. References to these case studies can be found in Section 5.4.2.1, successful applications of alternatives. The estimated remedial efficiencies

presented apply to all organic COCs for biosurfactants. For enhanced bioremediation, land spreading, institutional controls and monitoring, and no action, the estimated remedial efficiencies apply to petroleum hydrocarbons. An efficiency for Aroclor 1254 remediation associated with biological alternatives is not included because Aroclor 1254 does not readily biodegrade under aerobic conditions. Aroclor 1254 was detected in only a single sample at one site at 3 mg/kg. This maximum concentration would be less than the concentration corresponding to an excess cancer risk of 10^{-4}, which, in general, is when EPA requires remedial action based on cancer risk under Superfund. The biological and limited action alternatives assume Aroclor 1254 will remain in place.

The following remedial efficiencies are used for all petroleum hydrocarbons compounds detected and are independent of time (over the short term, e.g., one year, biodegradation would be significantly less efficient than active remedial alternatives like biosurfactants):

- Biosurfactants - 90 percent (case studies indicate a higher efficiency, but the unique application may result in a loss of efficiency); and

- Containment - 90 percent containment, 0 percent remediation.

The following efficiencies are used for DRPH, GRPH, RRPH, and benzene:

- Enhanced bioremediation - 94 percent;
- Land spreading - 75 percent; and
- Institutional controls and monitoring; and no action - 50 percent. (Naturally occurring bioremediation)

The post-remedial concentration is estimated using the following formula (assuming no time constraints):

Post-remedial Concentration = Initial Concentration x (1 - Remedial Efficiency)

5.4.1.4 Project Duration. The estimated duration of each remedial alternative and associated project schedule is an important consideration because of the seasonal limitations on outdoor work and the lack of personnel to perform operation and maintenance activities in this remote location. The North Slope of Alaska is frozen and covered with snow and ice for the majority of the year, leaving a period of only approximately 100 days in the summer when the weather is favorable for outdoor work. Outdoor phases of remedial actions significantly longer than 100 days must be suspended until the following summer, causing a marked increase in duration because of the extended winter down time. In order to maximize efficiency, remedial alternatives were designed either to complete outdoor phases of remediation within this narrow time frame or extend over a longer term and require only minimal labor.

Project durations are based on case studies from Alaska. The rates of biological degradation for enhanced bioremediation, land spreading, and naturally occurring bioremediation associated with institutional controls and monitoring are expressed as a first order decay function. The first-order decay function used to model this biological degradation is $C = C_0\ e^{-kt}$ (C is final

concentration, C_0 is the initial concentration, e is the natural logarithm, k is a constant based on case studies, and t is time).

The rate constant, k, is estimated based on related case studies. In general, the k-values presented reflect the lower end of the expected range of values. These values are then downwardly adjusted because of the arctic environment conditions. The lowest rates are associated with no action and institutional controls and monitoring because there is no enhancement of conditions. The next lowest rate is associated with land spreading because adding moisture and oxygen are but two of several factors that can be optimized, and the climate factor is unaffected. Enhanced bioremediation ranks highest because more factors are optimized. DRPH is used to estimate the constants for all of the petroleum hydrocarbons because it represents by far the highest concentrations at all of the sites. The concentration of DRPH, therefore, is the controlling factor in determining the effectiveness of the remedial alternatives for these sites. The following constants and criteria were used for estimation of remedial rates:

DRPH Reduction

No action and Institutional controls and monitoring (Natural, unassisted bioremediation) $k = 0.0025/day$

The k-value for no action and institutional controls and monitoring is based on rate data from a control cell in an experiment to measure the effectiveness of enhanced bioremediation (Liddell et al. 1991). The case study k-value was decreased in an attempt to offset the bias that aeration of the control cell introduces.

Land Spreading $k = 0.005/day$

The decay constant for land spreading is estimated to fall between a case study involving lime and nutrient addition (Song et al. 1990) and the control cell data cited above for natural unassisted biodegradation.

Enhanced Bioremediation $k = 0.008/day$

This rate is based on the rates found from observing a number of case studies. It represents a downward adjustment of the low end of the range of decay constants observed because many of the case studies took place under climatic conditions more favorable than those which exist at Oliktok Point.

A comparison of the predicted degradation of DRPH using the bioremedial alternatives being evaluated is illustrated in Figure 5-7. (No action and institutional controls and monitoring are both represented by natural unassisted bioremediation.)

The duration of onsite remedial activity and the total project duration are presented in Attachment B. These durations are defined as follows:

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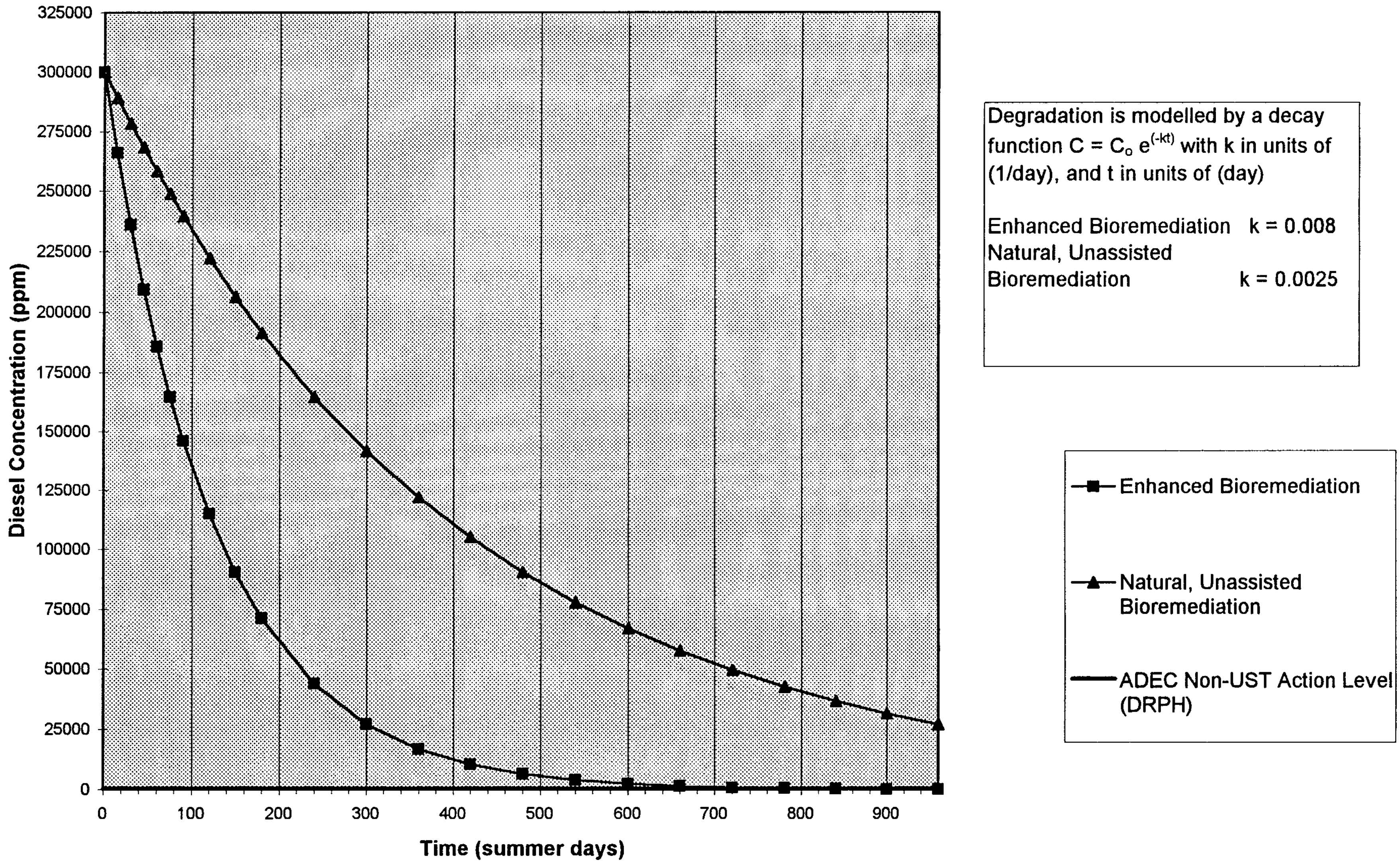
Figure 5-7. Comparative Biodegradation of Diesel Fuel in Soils
(Basis: Maximum Diesel Concentration of 300,000 at Oliktok Point)



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- Duration of onsite remedial activity includes all onsite activities related to conducting the remedial action: sampling, operating remedial equipment, mobilization, and demobilization (this is a quantification of the relative duration estimate). The durations for alternatives involving bioremediation are limited to three years. Over three years, based on the estimated rate of biodegradation of DRPH, the maximum concentrations of COCs will not have reached the target cleanup levels. However, they will have diminished sufficiently in concentration to demonstrate a trend in that direction, and the majority of the contaminated areas will likely be below target cleanup levels.

- Total project duration includes the duration of onsite remedial activity, as well as time required for preparing planning documents, conducting permitting activities, and closure.

5.4.1.5 Data Gaps. Data gaps include any environmental testing or treatability studies that must be done to determine the effectiveness of a given remedial alternative under site conditions.

Alternatives are analyzed comparatively, in Sections 5.4.3 and 5.4.4 based on the AFCEE criteria above, and the nine criteria in the NCP, respectively. The preferred remedial alternatives are identified in Section 5.4.5.

5.4.2 Detailed Evaluation of Alternatives

This section presents a detailed evaluation of remedial alternatives for the four sites requiring remedial action at the Oliktok Point radar installation: the Diesel Spill (SS05), Gasoline Storage Area (ST08), Garage (SS10), and the Old Sewage Area Petroleum Spill (SS11). Alternatives are developed by medium, i.e., gravel, tundra, and the soil beneath the Garage (SS10), rather than by site. Table 5-10 summarizes the remedial alternatives evaluated in Sections 5.4.2.1 through 5.4.2.5.

5.4.2.1 Successful Applications of Alternatives.

For brevity, alternatives that apply to more than one medium are described only once.

No Action. As part of a study on bioremediation of DRPH-contaminated gravel pads and soils near Prudhoe Bay, a control cell was left unassisted and untreated. This control cell represents, in essence, natural attenuation. Initial DRPH concentration was approximately 1,900 mg/kg. After nine weeks the DRPH concentration had decreased to 1,200 mg/kg. This indicates a reduction of 37 percent in DRPH concentration in 63 days. In addition, a slight increase in the microbial population was noted (Liddell et al. 1991). The difference between a control cell and undisturbed gravel is that the control cell material is oxygenated as it is placed in the cell. As a result, the rate and magnitude of reduction is probably greater than that for undisturbed soil or gravel. Therefore, the estimated efficiency of no action is 50 percent over three years.

TABLE 5-10. SUMMARY OF REMEDIAL ALTERNATIVES BY MEDIUM

MEDIUM	SITES	REMEDIAL ALTERNATIVES
Gravel	Diesel Spill (SS05) Gasoline Storage Area (ST08) Garage (SS10)	• No action • Institutional controls and monitoring • Enhanced bioremediation • Land spreading
Tundra	Diesel Spill (SS05) Gasoline Storage Area (ST08) Garage (SS10) Old Sewage Area Petroleum Spill (SS11)	• No action • Institutional controls and monitoring • Enhanced bioremediation
Soil Beneath Garage	Garage (SS10)	• No action • Institutional controls and monitoring • Containment • Enhanced bioremediation • Biosurfactants

Institutional Controls and Monitoring. The bioremediation study noted above applies to this remedial alternative, and estimated efficiency is 50 percent.

Containment. Although there are no examples of maintaining freezing conditions to contain contaminants on the North Slope, the method has been developed as an innovative technology in the lower 48 states. Low maintenance approaches of insulation and heat exchangers are also routinely used in Alaska to protect the integrity of stilted structures by keeping the level of permafrost at the ground surface.

Enhanced Bioremediation. Enhanced bioremediation has been successfully implemented in the arctic environment to treat petroleum hydrocarbon contamination on the North Slope. Studies at Point Thompson and Kuparuk oil fields in Alaska show that enhanced bioremediation is an efficient method for reducing the concentration of petroleum hydrocarbons to a desired level within a relatively short time. The Point Thompson case study shows that 16,000 cubic yards of TPH-contaminated gravel with an initial concentration of 2,000 to 3,000 ppm was bioremediated to an average concentration of 285 ppm between July and September 1990 (Liddell et al. 1991).

The estimated remedial action efficiency of enhanced bioremediation is estimated at 94 percent over three years based on case studies done in Alaska and estimates of biodegradation kinetics.

Land Spreading. Land spreading is a recognized method for remediating petroleum hydrocarbons in gravel in Alaska. There are established regulations for the approach. Ample space to spread the estimated volume of contaminated gravel in two-inch lifts on clean gravel may not be available. Based on the estimated volume of gravel, approximately 13.5 acres are needed. Thicker lifts (e.g., 6 inches) would have to be negotiated. Absorbent materials will be used around the perimeter to prevent runoff from the addition of moisture. The area will be

fenced with a silt fence to minimize the migration of fine particles from the area and to prevent exposure to visitors.

The estimated remedial efficiency of 75 percent over three years for this approach is based on an assumption that it will fall between the efficiencies for enhanced bioremediation (with nutrients and moisture added) and natural biodegradation because spreading increases aeration and moisture will be added, but no nutrients are included.

Biosurfactants. Biosurfactants were used successfully in cleaning petroleum from rocks and underlying sands and soils in the Prince William Sound area in 1993 (Tesoro/PES 1993). They also were used successfully in cleaning hydrocarbon contamination from rocks and soils at a refinery in Kenai, Alaska in 1992 (Tesoro/PES 1992). Specific North Slope case studies have not been identified, but the site conditions, especially the shallow permafrost beneath the structures and existing drainage, should allow for collection of any materials introduced by this process. A wastewater discharge permit may be required.

The estimated remedial action efficiency for biosurfactants is 90 percent, based on a downward adjustment of the 97 percent reduction found in a case study done at the Tesoro Kenai Refinery (Tesoro/PES 1992). This efficiency should be possible under conditions found on the North Slope; however, it may be difficult to access all contaminated areas beneath the Garage (SS10) at Oliktok Point.

5.4.2.2 Project Costs. A summary of project costs for the remedial alternatives is included in Tables 5-11 through 5-13 by medium. Detailed cost estimates for each remedial alternative are located in Attachment A.

5.4.2.3 Contaminant Reduction. The degree to which COCs will meet target cleanup levels (proposed remediation goals) for each alternative for all three media is summarized in Table 5-14. This measure is presented as post-remedial concentration, or the initial concentration of DRPH multiplied by one minus the projected efficiency. DRPH is selected because its concentration is so much greater than the other COCs that it will drive the selection of the remedial alternative.

5.4.2.4 Project Duration. A breakdown of the project durations for the remedial alternatives is shown in Tables 5-15 through 5-17. Detailed project duration tables for each of the alternatives are located in Attachment B.

No Action. Project duration for no action involves closure reporting only.

Institutional Controls and Monitoring. The duration of natural unassisted bioremediation for institutional controls and monitoring will be the same as that for no action, but there will be monitoring of this reduction. In this case, it is assumed that natural, unassisted biodegradation of COCs will show a clear trend towards the target cleanup level based on periodic sampling.

TABLE 5-11. SUMMARY OF PROJECT COSTS FOR REMEDIAL ACTION ALTERNATIVES FOR GRAVEL

REMEDIAL ALTERNATIVE	TECHNOLOGY TESTING	CAPITAL COST	TOTAL LABOR	OPERATING COST	ENVIRONMENTAL TESTING	CLOSURE COST	ADMINISTRATIVE AND OTHER INDIRECT COSTS	PRESENT VALUE
No action	$0	$0	$0	$0	$0	$5,000	$750	$5,750
Institutional controls and monitoring	$0	$100	$29,320	$16,675	$2,330	$4,320	$14,075	$66,815
Enhanced bioremediation	$7,500	$4,515	$74,505	$42,125	$2,330	$4,320	$34,710	$170,000
Land spreading	$7,500	$18,345	$92,690	$48,225	$2,330	$4,320	$44,240	$217,640

TABLE 5-12. SUMMARY OF PROJECT COSTS FOR REMEDIAL ACTION ALTERNATIVES FOR TUNDRA

REMEDIAL ALTERNATIVE	TECHNOLOGY TESTING	CAPITAL COST	TOTAL LABOR	OPERATING COST	ENVIRONMENTAL TESTING	CLOSURE COST	ADMINISTRATIVE AND OTHER INDIRECT COSTS	PRESENT VALUE
No action	$0	$0	$0	$0	$0	$5,000	$750	$5,750
Institutional controls and monitoring	$0	$100	$29,320	$16,675	$3,100	$4,320	$14,285	$67,800
Enhanced bioremediation	$7,500	$2,630	$74,505	$40,875	$3,100	$4,320	$34,610	$169,430

TABLE 5-13. SUMMARY OF PROJECT COSTS FOR REMEDIAL ACTION ALTERNATIVES FOR SOIL BENEATH THE GARAGE (SS10)

REMEDIAL ALTERNATIVE	TECHNOLOGY TESTING	CAPITAL COST	TOTAL LABOR	OPERATING COST	ENVIRONMENTAL TESTING	CLOSURE COST	ADMINISTRATIVE AND OTHER INDIRECT COSTS	PRESENT VALUE
No action	$0	$0	$0	$0	$0	$5,000	$750	$5,750
Institutional controls and monitoring	$0	$100	$29,320	$17,375	$775	$4,320	$13,830	$65,720
Containment	$0	$46,665	$68,630	$30,000	$0	$0	$21,795	$167,090
Enhanced bioremediation	$7,500	$2,470	$74,505	$40,875	$775	$4,320	$33,505	$164,110
Biosurfactants	$7,500	$10,900	64,910	$37,725	$775	$4,535	$31,720	$158,065

TABLE 5-14. ESTIMATED POTENTIAL CONTAMINANT REDUCTION (ALL MEDIA)

ALTERNATIVE	MEDIUM	CONTAMINANTS	INITIAL CONCENTRATION OF DRPH* (mg/kg)	TARGET CLEANUP LEVEL FOR DRPH[a] (mg/kg)	POST REMEDIAL CONCENTRATION FOR DRPH* (mg/kg)
No action	Gravel	DRPH, GRPH	22,270	500	11,135
	Tundra	DRPH, GRPH, RRPH, Benzene	89,400	500	44,700
	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	75,000	500	37,500
Institutional controls and monitoring	Gravel	DRPH, GRPH	22,270	500	11,135
	Tundra	DRPH, GRPH, RRPH, Benzene	89,400	500	44,700
	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	75,000	500	37,500
Enhanced bioremediation	Gravel	DRPH, GRPH	22,270	500	1,335
	Tundra	DRPH, GRPH, RRPH, Benzene	89,400	500	5,364
	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	75,000	500	4,500
Biosurfactants	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	75,000	500	7,500
Land spreading	Gravel	DRPH, GRPH	22,270	500	5,568
Containment	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	75,000	500	75,000[b]

* Based on the average of the maximum concentrations detected from individual sites. The average media-specific post-remedial concentrations will be significantly lower because the average initial concentrations are much lower than the average maximum.

a The target cleanup level for DRPH in soil is based on ADEC Non-UST guidance and does not necessarily correspond to final site-specific cleanup goals.

b Containment involves no treatment; therefore, the post-remedial concentration is unchanged. It is estimated to reduce containment mobility by 90 percent.

TABLE 5-15. ESTIMATED PROJECT DURATION FOR REMEDIAL ACTION ALTERNATIVES FOR GRAVEL

REMEDIAL ALTERNATIVE	DURATION OF ONSITE REMEDIAL ACTIVITY (Days)	TOTAL PROJECT DURATION (Days)
No action	0	30
Institutional controls and monitoring	13	881
Enhanced bioremediation	30	988
Land spreading	51	919

TABLE 5-16. ESTIMATED PROJECT DURATION FOR REMEDIAL ACTION ALTERNATIVES FOR TUNDRA

REMEDIAL ALTERNATIVE	DURATION OF ONSITE REMEDIAL ACTIVITY (Days)	TOTAL PROJECT DURATION (Days)
No action	0	30
Institutional controls and monitoring	13	881
Enhanced bioremediation	30	988

TABLE 5-17. ESTIMATED PROJECT DURATION FOR REMEDIAL ACTION ALTERNATIVES FOR SOIL BENEATH THE GARAGE (SS10)

REMEDIAL ALTERNATIVE	DURATION OF ONSITE REMEDIAL ACTIVITY (Days)	TOTAL PROJECT DURATION (Days)
No action	0	30
Institutional controls and monitoring	13	881
Containment	29	119
Enhanced bioremediation	30	988
Biosurfactants	21	530

Containment. Project duration is assumed to be predominantly planning activities. The length of time the containment system would remain in place is uncertain and not included in the estimate. That length of time hinges either on a decision by the Air Force to dismantle the Garage or on the emergence of new remedial technology.

Enhanced Bioremediation. Project durations are based on the assumption that, in the case of enhanced bioremediation, reduction of maximum concentrations of COCs to target levels will occur within three years of the start of the project or show through periodic monitoring a clear trend in that direction. This clear trend will justify site closure even if the target cleanup level has not been met. Enhanced bioremediation will occur during summer months only because the gravel will be frozen the rest of the year. The target cleanup levels for DRPH and GRPH, again, are based on guidance and are negotiable with ADEC. Case studies cited support this approach and, if the average of site concentrations above the target cleanup level were used as the initial concentration, it is apparent that reduction could occur more quickly (see Figure 5-7).

Land Spreading. Several assumptions are made concerning land spreading based on case studies and best engineering judgement. Technology testing will be necessary for the alternative involving land spreading to determine its feasibility under site-specific conditions and to provide information for detailed design. Technology testing is expected to take about 60 days. This should not affect the start of the onsite remedial activities, provided that sufficient time is allowed for this to occur before other onsite activities begin.

Biosurfactants. Project duration in the field is very short because the technology can be employed rapidly. The majority of the estimated duration is related to planning activities including treatability testing and in the year after field activities are complete in which the petroleum hydrocarbons in rinse water are allowed to biodegrade in either a tank or drums.

5.4.2.5 Data Gaps. Data gaps are described organized by remedial alternative. Remedial alternatives that apply to more than one medium are described only once since the data gaps are independent of medium.

No Action. The data gaps are the lack of information on site-specific biodegradation potential.

Institutional Controls and Monitoring. The data gaps are the lack of information on site-specific biodegradation potential.

Containment. The data gaps relate to design specifications including the most appropriate method for maintaining freezing conditions and the method for accessing the underside of the Garage (SS10).

Enhanced Bioremediation. The data gap is the lack of information on site-specific biodegradation potential. A treatability study will be necessary to determine the biodegradation potential of contaminants in each medium, and to determine the type and amount of nutrient additions to enhanced biodegradation. Several parameters must be investigated, including pH and baseline microbial activity.

Land Spreading. The data gaps are the lack of information on site-specific biodegradation potential and the question of available area. A treatability study will be necessary to determine biodegradation potential. Several parameters must be investigated, including pH and baseline microbial activity.

Biosurfactants. Accessibility and associated effectiveness of the air knives beneath the Garage (SS10) are the data gaps. Clearance beneath the Garage (SS10) is variable and sometimes less than two feet. A treatability study will be necessary. Several parameters must be investigated, including pH and baseline microbial activity.

5.4.3 Summary of Detailed Evaluation of Remedial Alternatives

Table 5-18 summarizes the remedial alternatives evaluated by medium.

5.4.4 Summary of the Nine Criteria

This section consists of an evaluation of the proposed alternatives, and are analyzed according to the following nine criteria required in the NCP:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and
- Community acceptance.

State acceptance and community acceptance will be based on comments received on the RI/FS report and the proposed remedial alternative for each site.

The evaluation of the nine criteria is presented in Tables 5-19 through 5-21. The following definitions of the nine criteria, taken from the EPA RI/FS Guidance Document and the NCP, were used:

Overall Protection of Human Health and the Environment. This criterion addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Compliance with ARARs. This criterion addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of federal and state environmental statutes and/or provide grounds for invoking a waiver.

TABLE 5-18. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED (ALL MEDIA)

ALTERNATIVE	MEDIUM	CONTAMINANTS	REMEDIAL ACTION EFFICIENCY FOR DRPH	AVERAGE INITIAL CONCENTRATION OF DRPH* (mg/kg)	TARGET CLEANUP LEVEL FOR DRPH (mg/kg)	POST REMEDIAL CONCENTRATION FOR DRPH (mg/kg)	BENCH OR TREATABILITY STUDY REQUIRED	LEVEL OF WORKER PROTECTION	PROJECT DURATION (Months)	PROJECT COST
No action	Gravel	DRPH, GRPH	50%	22,270	500	11,135	NO	D	1	$5,750
	Tundra	DRPH, GRPH, RRPH, Benzene	50%	89,400	500	44,700	NO	D	1	$5,750
	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	50%	75,000	500	37,500	NO	D	1	$5,750
Institutional controls and monitoring	Gravel	DRPH, GRPH	50%	22,270	500	11,135	NO	D	29	$66,815
	Tundra	DRPH, GRPH, RRPH, Benzene	50%	89,400	500	44,700	NO	D	29	$67,800
	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	50%	75,000	500	37,500	NO	D	29	$65,720
Containment	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	90% (reduction in mobility only)	75,000	500	75,000[b]	NO	C	4	$167,090
Enhanced bioremediation	Gravel	DRPH, GRPH	94%	22,270	500	1,335	YES	D	33	$170,000
	Tundra	DRPH, GRPH, RRPH, Benzene	94%	89,400	500	5,364	YES	D	33	$169,430
	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	94%	75,000	500	4,500	YES	D	33	$164,110
Biosurfactants	Soil Beneath Garage	DRPH, GRPH, RRPH, Aroclor 1254	90%	75,000	500	7,500	YES	C	18	$158,065
Land spreading	Gravel	DRPH, GRPH	75%	22,270	500	5,570	YES	D	34	$217,640

* Based on the average of the maximum concentrations from individual sites.
a The target cleanup level for DRPH in soil is based on ADEC Non-UST guidance and does not necessarily correspond to final site-specific cleanup goals.
b Based on 0 percent reduction in contaminant concentration.

TABLE 5-19. EVALUATION OF NINE CRITERIA FOR GRAVEL

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	ENHANCED BIOREMEDIATION	LAND SPREADING
1. Overall Protection of Human Health and the Environment	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness. It may not comply with chemical-specific ARARs within 3 years but will eventually especially if average concentrations are considered.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness though it may not comply with chemical-specific ARAR. There may be insufficient space to spread gravel.
2. Compliance with ARARs	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unassisted bioremediation is unsuccessful.	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unassisted bioremediation is unsuccessful.	The use of this technology will comply with action specific and location specific ARARs. Chemical specific ARARs will probably be met if average concentrations are used.	The use of this technology may not comply with all chemical specific ARARs, but does comply with action and location specific ARARs.
3. Long-term Effectiveness and Permanence	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative provides sufficient long-term effectiveness because the estimated residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.	This alternative provides sufficient long-term effectiveness because the estimated residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.
4. Reduction of Toxicity, Mobility, and Volume Through Treatment	Results in a reduction in toxicity through natural biodegradation.	Results in a reduction in toxicity through natural biodegradation.	Results in a reduction in toxicity through treatment.	Results in a reduction in toxicity through treatment.
5. Short-Term Effectiveness	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.
6. Implementability	This alternative should be technically and administratively implementable, provided that the risk management decisions are acceptable to ADEC.	This alternative is technically and administratively implementable.	Technical implementability will be determined by performing a treatability study. Administrative implementability issues include securing permit. Materials are readily available.	This alternative is probably not technically implementable because space is not available for spreading unless a solid waste disposal permit can be negotiated with thicker lifts (e.g., 6 inches). Materials are rea[illegible]ailable.

TABLE 5-19. EVALUATION OF NINE CRITERIA FOR GRAVEL (CONTINUED)

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	ENHANCED BIOREMEDIATION	LAND SPREADING
7. Cost	$5,750	$66,815	$170,000	$217,640
8. State/Support Agency	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.
9. Community Acceptance	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.

TABLE 5-20. EVALUATION OF NINE CRITERIA FOR TUNDRA

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	ENHANCED BIOREMEDIATION
1. Overall Protection of Human Health and the Environment	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness. It may not comply with chemical-specific ARARs within 3 years but will eventually especially if average concentrations are considered.
2. Compliance with ARARs	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unassisted bioremediation is unsuccessful.	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unassisted bioremediation is unsuccessful.	The use of this technology will probably comply with all chemical specific ARARs if average concentrations are considered, and with action and location specific ARARs.
3. Long-term Effectiveness and Permanence	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative provides sufficient long-term effectiveness because the estimated residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.
4. Reduction of Toxicity, Mobility, and Volume Through Treatment	Results in a reduction in toxicity through natural biodegradation.	Results in a reduction in toxicity through natural biodegradation.	Results in a reduction in toxicity through treatment.
5. Short-term Effectiveness	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.
6. Implementability	This alternative should be technically and administratively implementable, provided that the risk management decisions are acceptable to ADEC.	This alternative is technically and administratively implementable.	Technical implementability will be determined by performing a treatability study. Administrative implementability issues include securing permit. Materials are readily available.
7. Cost	$5,750	$67,800	$169,430
8. State/Support Agency	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.
9. Community Acceptance	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.

TABLE 5-21. EVALUATION OF NINE CRITERIA FOR THE SOIL BENEATH THE GARAGE (SS10)

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	CONTAINMENT	ENHANCED BIOREMEDIATION	BIOSURFACTANTS
1. Overall Protection of Human Health and the Environment	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative is protective of human health and the environment as a temporary measure as long as freezing conditions are maintained.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness. It may not comply with chemical-specific ARARs within 3 years but will eventually especially if average concentrations are considered.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness. It may not comply with chemical-specific ARARs.
2. Compliance with ARARs	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unassisted bioremediation is unsuccessful.	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unassisted bioremediation is unsuccessful.	This alternative complies with action-specific and location-specific ARARs. It does not comply with chemical-specific ARARs.	The use of this technology may not comply with all chemical specific, but does comply with action and location specific ARARs.	The use of this technology may not comply with all action specific, and location specific ARARs. It may not comply with all chemical specific ARARs.
3. Long-term Effectiveness and Permanence	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential of gravel.	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative does not provide long term effectiveness or permanence. It is intended to be a temporary measure.	This alternative provides sufficient long-term effectiveness because the estimated residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.	This alternative provides sufficient long-term effectiveness because the estimated residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are removed and treated ex situ.
4. Reduction of Toxicity, Mobility, and Volume Through Treatment	Results in a reduction in toxicity through natural biodegradation.	Results in a reduction in toxicity through natural biodegradation.	Results in no reduction in toxicity through treatment.	Results in a reduction in toxicity through treatment.	Results in a reduction in volume through treatment.

TABLE 5-21. EVALUATION OF NINE CRITERIA FOR THE SOIL BENEATH THE GARAGE (SS10) (CONTINUED)

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	CONTAINMENT	ENHANCED BIOREMEDIATION	BIOSURFACTANTS
5. Short-Term Effectiveness	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.	This alternative will present no detrimental effect on the environment or surrounding area. Workers may be exposed to COCs and difficult working conditions beneath the Garage.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level C since biosurfactants may act as an irritant.
6. Implementability	This alternative should be technically and administratively implementable, provided that the risk management decisions are acceptable to ADEC.	This alternative is technically and administratively implementable.	This alternative should be technically and administratively implementable.	Technical implementability will be determined by performing a treatability study. Administrative implementability issues include securing permit. Materials are readily available.	This alternative should be technically implementable if runoff can be controlled and all of the contamination accessed. Administrative implementability issues include securing permits. Materials are readily available.
7. Cost	$5,750	$65,720	$167,090	$164,110	$158,065
8. State/Support Agency	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.
9. Community Acceptance	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.

Long-Term Effectiveness and Permanence. This criterion refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

Reduction of Toxicity, Mobility, or Volume Trough Treatment. This criterion is the anticipated performance of the treatment technologies a remedy may employ (reflects the anticipated performance of treatment).

Short-Term Effectiveness. This criterion addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

Implementability. This criterion is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

Cost. Cost includes estimated capital and operation and maintenance costs, and net present work costs.

State Acceptance. State acceptance addresses the technical or administrative issues and concerns the support agency may have regarding each alternative.

Community Acceptance. Community acceptance addresses the issues and concerns the public may have regarding each of the alternatives.

5.4.5 Preferred Alternative

The selection of a preferred alternative shall be viewed as a general approach rather than a specific action because there are uncertainties regarding the effectiveness of the remedial alternatives in the unusual environmental of the North Slope, future land use, and availability and timing of funding to perform remedial actions. As a result, the alternatives identified in this report as preferred should not be considered the final word. Instead, they should be considered the best available approach pending treatability testing and remedial design.

The preferred alternatives and their estimated costs are listed below by medium:

<u>Gravel</u>

Enhanced bioremediation contingent on treatability study. The next best alternative is institutional controls and monitoring.	$170,000

Tundra

Enhanced bioremediation contingent on treatability study. Institutional controls and monitoring is the next best alternative.	$169,430

Soil beneath the Garage (SS10)

Enhanced bioremediation contingent on treatability study. Containment is the next best alternative.	$164,110
Total	$503,540

The high concentration of DRPH and other petroleum hydrocarbons makes alternatives that involve active reduction of contamination preferable to no action and institutional controls and monitoring. Among the active reduction alternatives, enhanced bioremediation is the least costly and most effective for gravel and tundra, assuming that treatability testing supports the viability of biodegradation and that an extensive delivery mechanism is not necessary to distribute oxygen, moisture (for gravel), and nutrients (if necessary). The next best alternative for gravel is institutional controls and monitoring. Natural unassisted biodegradation will eventually reduce the concentrations of petroleum hydrocarbons to acceptable levels, and institutional controls could be implemented to minimize exposure of humans and the environment during the biodegradation process. The cost for institutional controls and monitoring is less then that for enhanced bioremediation.

The preferred alternative for tundra is enhanced bioremediation. The next best alternative for tundra is to implement institutional controls and monitoring. Remedial alternatives more aggressive than enhanced biodegradation will likely lead to greater damage than benefit to fragile tundra.

The soil beneath the Garage poses a difficult problem as long as the building remains in place. The installation is active, so dismantling the Garage is not an option at present. The alternative that is most likely to meet ADEC and public approval is some effort at actively reducing the contamination. Enhanced bioremediation, therefore, should be the preferred alternative, contingent on a successful treatability study. If enhanced bioremediation is not viable, the next best alternative is to contain the contaminants until the building is dismantled or a better remedial alternative is developed.

Since enhanced bioremediation is the preferred alternative for all three media, the cost estimates for each medium include some redundancy (mobilization, planning documents, travel, per diem, etc.). To reflect the estimated cost more accurately, a combined cost estimate has been prepared. The cost estimate and the associated duration estimate are located in Attachments A and B. The estimated remedial cost of the combined remediation of all media using enhanced bioremediation is $218,230. This cost includes added time for field activities to account for the combined areas.

5.5 SITING STUDY

Siting of remedial equipment should not be a major concern at Oliktok Point, because no large remedial units will be used.

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ATTACHMENT A
COST ESTIMATES

Alternative: No Action

Estimated Costs

<u>Sites:</u>	Media:	Gravel	
Diesel Spill (SS05)	Total volume:	5,052 CY	
Gasoline Storage Area (ST08)	Project duration:	1 Month	(30 days)
Garage (SS10)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Total Capital Cost over the 1 Month Project				$0	$0
OPERATING COSTS:					
Closure	1	Event	$5,000.00	$5,000	
Total Operating Cost over the 1 Month Project				$5,000	$0
Total Direct Cost over the 1 Month Project				$5,000	$0
Procurement costs (0%)				$0	$0
Overhead (10%)				$500	$0
Contingency (5%)				$250	$0
Total Administrative Cost over the 1 Month Project				$750	$0
NET PRESENT WORTH					$5,750

* Estimated discount rate for calculating present value of future costs

Alternative: Institutional Controls and Monitoring

Estimated Costs

Sites:	Media:	Gravel	
Diesel Spill (SS05),	Total volume:	5,052 CY	
Gasoline Storage Area (ST08),	Project duration:	30 Months	(881 days)
Garage (SS10)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (Work plan, SAP, QAPjP, H&S)	2	Report	$5,000.00	$10,000	
Misc. Equipment and Supplies	1	Lump Sum	$100.00	$100	
Total Capital Cost over the 30 Month Project				$10,100	$0
OPERATING COSTS:					
Implement Institutional Controls	1	Event	$10,000.00	$10,000	
Sampling (initial)	12	Samples	$70.00	$840	
Sampling (annual)	2	Event	$840.00		$1,680
Labor	240	Hr	$70.00	$16,800	
Per Diem	26	Days	$175.00	$4,550	
Project Management	36	Hr	$70.00	$2,520	
Closure (Month 30)	1	Report	$5,000.00		$5,000
Travel for Sampling	4	Trips	$1,200.00		$4,800
Total Operating Cost over the 30 Month Project				$34,710	$11,480
Total Direct Cost over the 30 Month Project				$44,810	$11,480
Procurement costs (5%)				$2,241	$574
Overhead (10%)				$4,481	$1,148
Contingency (10%)				$4,481	$1,148
Total Administrative Cost over the 30 Month Project				$11,203	$2,870
NET PRESENT WORTH					**$66,814**

* Estimated discount rate for calculating present value of future costs

Alternative: Enhanced Bioremediation
Estimated Costs

<u>Sites:</u>	Media:	Gravel	
Diesel Spill (SS05)	Total volume:	5,052 CY	
Gasoline Storage Area (ST08)	Project duration:	33 Months	(988 days)
Garage (SS10)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Develop Specifications (30%, 95%, 100%)	3	Report	$5,000.00	$15,000	
Permitting (Air or Water)	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Nutrients	2,021	Lb	$1.00	$2,021	
Empty sand bags	47	Bag	$0.47	$22	
Hose	1	Hose	$50.00	$50	
Booms	5	Boom	$24.53	$123	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	46	Day	$10.00	$460	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 33 Month Project				$44,015	$0
OPERATING COSTS:					
Mobilize/Demobilize	1	Event	$30,000.00	$30,000	
Transport Nutrients					
Transport Equipment					
Labor	528	Hr	$70.00	$36,960	
Per diem	50	Day	$200.00	$10,000	
Sampling & Analysis (initial)	12	Sample	$70.00	$840	
Sampling & Analysis (annual)	2	Event	$840.00		$1,680
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	79	Hr	$70.00	$5,544	
Closure (Month 33)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 33 Month Project				$83,344	$11,480
Total Direct Cost over the 33 Month Project				$127,359	$11,480
Procurement costs (5%)				$6,368	$574
Overhead (10%)				$12,736	$1,148
Contingency (10%)				$12,736	$1,148
Total Administrative Cost over the 33 Month Project				$31,840	$2,870
NET PRESENT WORTH					**$170,001**

* Estimated discount rate for calculating present value of future costs

Alternative: Land Spreading

Estimated Costs

<u>Sites:</u>	Media:	Gravel	
Diesel Spill (SS05)	Total volume:	5,052 CY	
Gasoline Storage Area (ST08)	Project duration:	31 Months	(919 days)
Garage (SS10)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents	3	Report	$5,000.00	$15,000	
(Work plan (or Landspreading Plan), QAPjP, and HASP)	2	Report	$5,000.00	$10,000	
Solid Waste Disposal Permit	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Empty sand bags	45	Bag	$0.47	$21	
Hose	500	LF	$1.00	$500	
Absorbant for runoff control	261	LF	$2.00	$522	
Trash pump	1	Month	$420.00	$420	
Personal H & S Expendibles	88	Day	$10.00	$880	
Silt Fencing	1	Lump Sum	$1,000.00	$1,000	
Back Hoe Rental	1	Month	$15,000	$15,000	
Total Capital Cost over the 31 Month Project				$52,843	$0
OPERATING COSTS:					
Mobilization of equipment for Landspreading	1	Event	$30,000.00	$30,000	
Labor	816	Hr	$70.00	$57,120	
Per diem	92	Day	$175.00	$16,100	
Sampling & Analysis (initial)	12	Sample	$70.00	$840	
Sampling & Analysis (annual)	2	Event	$840.00		$1,680
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	122	Hr	$70.00	$8,568	
Closure (Month 31)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 31 Month Project				$112,628	$11,480
Total Direct Cost over the 31 Month Project				$165,471	$11,480
Procurement costs (5%)				$8,274	$574
Overhead (10%)				$16,547	$1,148
Contingency (10%)				$16,547	$1,148
Total Administrative Cost over the 31 Month Project				$41,368	$2,870
NET PRESENT WORTH					**$217,641**

* Estimated discount rate for calculating present value of future costs

Alternative: No Action
Estimated Costs

Sites:	Media:	Tundra	
Diesel Spill (SS05), Gasoline Storage	Total volume:	5,037 CY	
Area (ST08), Garage (SS10), Old	Project duration:	1 Month	(30 days)
Sewage Area Petroleum Spill (SS11)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Total Capital Cost over the 1 Month Project				$0	$0
OPERATING COSTS:					
Closure	1	Event	$5,000.00	$5,000	
Total Operating Cost over the 1 Month Project				$5,000	$0
Total Direct Cost over the 1 Month Project				$5,000	$0
Procurement costs (0%)				$0	$0
Overhead (10%)				$500	$0
Contingency (5%)				$250	$0
Total Administrative Cost over the 1 Month Project				$750	$0
NET PRESENT WORTH					**$5,750**

* Estimated discount rate for calculating present value of future costs

Alternative: Institutional Controls and Monitoring

Estimated Costs

<u>Sites:</u>	Media:	Tundra	
Diesel Spill (SS05), Gasoline Storage	Total volume:	5,037 CY	
Area (ST08), Garage (SS10), Old	Project duration:	30 Months	(881 days)
Sewage Area Petroleum Spill (SS11)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (Work plan, SAP, QAPjP, H&S)	2	Report	$5,000.00	$10,000	
Misc. Equipment and Supplies	1	Lump Sum	$100.00	$100	
Total Capital Cost over the 30 Month Project				$10,100	$0
OPERATING COSTS:					
Implement Institutional Controls	1	Event	#########	$10,000	
Sampling (initial)	16	Samples	$70.00	$1,120	
Sampling (annual)	2	Event	$1,120.00		$2,240
Labor	240	Hr	$70.00	$16,800	
Per Diem	26	Days	$175.00	$4,550	
Project Management	36	Hr	$70.00	$2,520	
Travel for Sampling	4	Trips	$1,200.00		$4,800
Closure (Month 30)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 30 Month Project				$34,990	$12,040
Total Direct Cost over the 30 Month Project				$45,090	$12,040
Procurement costs (5%)				$2,255	$602
Overhead (10%)				$4,509	$1,204
Contingency (10%)				$4,509	$1,204
Total Administrative Cost over the 30 Month Project				$11,273	$3,010
NET PRESENT WORTH					**$67,800**

* Estimated discount rate for calculating present value of future costs

Alternative: Enhanced Bioremediation
Estimated Costs

Sites:	Media:	Tundra	
Diesel Spill (SS05), Gasoline Storage	Total volume:	5,037 CY	
Area (ST08), Garage (SS10), Old	Project duration:	33 yr	(988 days)
Sewage Area Petroleum Spill (SS11)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Develop Specifications (30%, 95%, 100%)	3	Report	$5,000.00	$15,000	
Permitting (Air or Water)	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Nutrients	2,015	Lb	$1.00	$2,015	
Empty sand bags	66	Bag	$0.47	$31	
Hose	1	Hose	$50.00	$50	
Booms	5	Boom	$24.53	$123	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	46	Day	$10.00	$460	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 33 Month Project				$44,018	$0
OPERATING COSTS:					
Mobilize/Demobilize	1	Event	$30,000.00	$30,000	
Transport Nutrients					
Transport Equipment					
Labor	528	Hr	$70.00	$36,960	
Per diem	50	Day	$175.00	$8,750	
Sampling & Analysis (initial)	16	Sample	$70.00	$1,120	
Sampling & Analysis (annual)	2	Event	$1,120.00		$2,240
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	79	Hr	$70.00	$5,544	
Closure (Year 33)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 33 Month Project				$82,374	$12,040
Total Direct Cost over the 33 Month Project				$126,392	$12,040
Procurement costs (5%)				$6,320	$602
Overhead (10%)				$12,639	$1,204
Contingency (10%)				$12,639	$1,204
Total Administrative Cost over the 33 Month Project				$31,598	$3,010
NET PRESENT WORTH					**$169,428**

* Estimated discount rate for calculating present value of future costs

Alternative: No Action
Estimated Costs

Site:	Media:	Soil beneath Garage	
Garage (SS10)	Total volume:	370 CY	
	Project duration:	1 Month	(30 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Total Capital Cost over the 1 Month Project				$0	$0
OPERATING COSTS:					
Closure	1	Event	$5,000.00	$5,000	
Total Operating Cost over the 1 Month Project				$5,000	$0
Total Direct Cost over the 1 Month Project				$5,000	$0
Procurement costs (0%)				$0	$0
Overhead (10%)				$500	$0
Contingency (5%)				$250	$0
Total Administrative Cost over the 1 Month Project				$750	$0
NET PRESENT WORTH					**$5,750**

* Estimated discount rate for calculating present value of future costs

Alternative: Institutional Controls and Monitoring
Estimated Costs

Site:	Media:	Soil beneath Garage
Garage (SS10)	Total volume:	370 CY
	Project duration:	30 Months (881 days)
	Discount rate:	5% *

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (Work plan, SAP, QAPjP, H&S)	2	Report	$5,000.00	$10,000	
Misc. Equipment and Supplies	1	Lump Sum	$100.00	$100	
Total Capital Cost over the 30 Month Project				$10,100	$0
OPERATING COSTS:					
Implement Institutional Controls	1	Event	$10,000.00	$10,000	
Sampling (initial)	4	Sample	$70.00	$280	
Sampling (annual)	2	Event	$280.00		$560
Labor	240	Hr	$70.00	$16,800	
Per Diem	30	Days	$175.00	$5,250	
Project Management	36	Hr	$70.00	$2,520	
Travel for Sampling	4	Trips	$1,200.00		$4,800
Closure (Month 30)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 30 MonthProject				$34,850	$10,360
Total Direct Cost over the 30 Month Project				$44,950	$10,360
Procurement costs (5%)				$2,248	$518
Overhead (10%)				$4,495	$1,036
Contingency (10%)				$4,495	$1,036
Total Administrative Cost over the 30 Month Project				$11,238	$2,590
NET PRESENT WORTH					**$65,718**

* Estimated discount rate for calculating present value of future costs

Alternative: Containment

Estimated Costs

Site:	Media:	Area Under Garage	
Garage (SS10)	Total volume:	370 CY	
	Project duration:	4 Months	(119 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Insulation	5,000	Sq Ft	$2.00	$10,000	
Gravel Cover	167	Ton	$100.00	$16,667	
Miscellaneous Equipment (including Heat Exchangers)	1	LS	$5,000.00	$5,000	
Total Capital Cost over the 4 Month Project				$46,667	$0
OPERATING COSTS:					
Mobilization	1	Event	$30,000.00	$30,000	
Labor	696	Hr	$70.00	$48,720	
Per diem	72	Day	$175.00	$12,600	
Project Management	104	Hr	$70.00	$7,308	
Total Operating Cost over the 4 Month Project				$98,628	$0
Total Direct Cost over the 4 Month Project				$145,295	$0
Procurement costs (0%)				$0	$0
Overhead (10%)				$14,529	$0
Contingency (5%)				$7,265	$0
Total Administrative Cost over the 4 Month Project				$21,794	$0
NET PRESENT WORTH					**$167,089**

* Estimated discount rate for calculating present value of future costs

Alternative: Enhanced Bioremediation
Estimated Costs

Site:	Media:	Soil beneath Garage
Garage (SS10)	Total volume:	370 CY
	Project duration:	33 Months (988 days)
	Discount rate:	5% *

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Develop Specifications (30%, 95%, 100%)	3	Report	$5,000.00	$15,000	
Permitting (Air or Water)	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Nutrients	148	Lb	$1.00	$148	
Empty sand bags	18	Bag	$0.47	$8	
Hose	1	Hose	$50.00	$50	
Booms	5	Boom	$24.53	$123	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	46	Day	$10.00	$460	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 33 Month Project				$42,129	$0
OPERATING COSTS:					
Mobilize/Demobilize	1	Event	$30,000.00	$30,000	
Transport Nutrients					
Transport Equipment					
Labor	528	Hr	$70.00	$36,960	
Per diem	50	Day	$175.00	$8,750	
Sampling & Analysis (initial)	4	Sample	$70.00	$280	
Sampling & Analysis (annual)	2	Event	$280.00		$560
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	79	Hr	$70.00	$5,544	
Closure (Month 33)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 33 Month Project				$81,534	$10,360
Total Direct Cost over the 33 Month Project				$123,663	$10,360
Procurement costs (5%)				$6,183	$518
Overhead (10%)				$12,366	$1,036
Contingency (10%)				$12,366	$1,036
Total Administrative Cost over the 33 Month Project				$30,916	$2,590
NET PRESENT WORTH					**$164,109**

* Estimated discount rate for calculating present value of future costs

Alternative: Biosurfactants
Estimated Costs

Site: Garage (SS10)	Media:	Soil beneath Garage
	Total volume:	370 CY
	Project duration:	18 Months (530 days)
	Discount rate:	5% *

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Develop Specifications (30%, 95%, 100%)	3	Report	$5,000.00	$15,000	
Permitting (Air & Water)	2	Permit	$2,000.00	$4,000	
Treatability study	1	Study	$7,500.00	$7,500	
Air Knife Purchase (pair)	1	Pair	$6,000.00	$6,000	
Compressor	1	Month	$2,000.00	$2,000	
Nutrients	148	Lb	$1.00	$148	
Empty sand bags	18	Bag	$0.47	$8	
Hose	500	LF	$1.00	$500	
Booms	5	Boom	$24.53	$123	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	28	Day	$10.00	$280	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 18 Month Project				$52,399	$0
OPERATING COSTS:					
Mobilization	1	Event	$30,000.00	$30,000	
Transport Biosurfactant					
Transport Equipment					
Labor	384	Hr	$70.00	$26,880	
Per diem	32	Day	$175.00	$5,600	
Sampling & Analysis (initial)	4	Sample	$70.00	$280	
Sampling & Analysis (final)	1	Event	$280.00		$280
Travel for Sampling	2	Trips	$1,200.00		$2,400
Project Management	58	Hr	$70.00	$4,032	
Closure (Month 18)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 18 Month Project				$66,792	$7,680
Total Direct Cost over the 18 Month Project				$119,191	$7,680
Procurement costs (5%)				$5,960	$384
Overhead (10%)				$11,919	$768
Contingency (10%)				$11,919	$768
Total Administrative Cost over the 18 Month Project				$29,798	$1,920
NET PRESENT WORTH					**$158,065**

* Estimated discount rate for calculating present value of future costs

Alternative: Enhanced Bioremediation
Estimated Costs

Sites:	Media:	All Media	
All sites	Total volume:	10,459 CY	
	Project duration:	34 Months	(1007 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Develop Specifications (30%, 95%, 100%)	3	Report	$5,000.00	$15,000	
Permitting (Air or Water)	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Nutrients	4,184	Lb	$1.00	$4,184	
Empty sand bags	94	Bag	$0.47	$44	
Hose	1	Hose	$50.00	$50	
Booms	5	Boom	$24.53	$123	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	84	Day	$10.00	$840	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 34 Month Project				$46,581	$0
OPERATING COSTS:					
Mobilize/Demobilize	1	Event	$30,000.00	$30,000	
Transport Nutrients					
Transport Equipment					
Labor	832	Hr	$70.00	$58,240	
Per diem	88	Day	$200.00	$17,600	
Sampling & Analysis (initial)	32	Sample	$70.00	$2,240	
Sampling & Analysis (annual)	2	Event	$2,240.00		$4,480
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	125	Hr	$70.00	$8,736	
Closure (Month 34)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 34 Month Project				$116,816	$14,280
Total Direct Cost over the 34 Month Project				$163,397	$14,280
Procurement costs (5%)				$8,170	$714
Overhead (10%)				$16,340	$1,428
Contingency (10%)				$16,340	$1,428
Total Administrative Cost over the 34 Month Project				$40,849	$3,570
NET PRESENT WORTH					**$218,227**

* Estimated discount rate for calculating present value of future costs

ATTACHMENT B
ESTIMATED PROJECT DURATIONS

Alternative: No Action
Estimated Project Duration

<u>Sites:</u>
Diesel Spill (SS05)
Gasoline Storage Area (ST08)
Garage (SS10)

Start Date: Day 1
Medium: Gravel

Activity	Duration	Start Date	End Date
Development of Closure Report	30 Days	Day 1	Day 30
Closure	0 Days	Day 30	Day 30
PROJECT DURATION	30 Days		

Alternative: Institutional Controls and Monitoring
Estimated Project Duration

Sites:
Diesel Spill (SS05),
Gasoline Storage Area (ST08), Start Date: Day 1
Garage (SS10) Medium: Gravel

Activity	Duration	Start Date	End Date
Development of Planning Documents	60 Days	Day 1	Day 60
Implementation of Institutional Controls	60 Days	Day 61	Day 120
Mobilization	2 Days	Day 121	Day 122
Preliminary Sampling	3 Days	Day 123	Day 125
Demobilization	2 Days	Day 126	Day 127
End of First Year Sampling	3 Days	Day 487	Day 489
End of Second Year Sampling	3 Days	Day 849	Day 851
Development of Closure Report	30 Days	Day 852	Day 881
Closure	0 Days	Day 881	Day 881
PROJECT DURATION	881 Days		

Alternative: Enhanced Bioremediation
Estimated Project Duration

Sites:
Diesel Spill (SS05)
Gasoline Storage Area (ST08)
Garage (SS10)

Start Date: Day 1
Media: Gravel

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	3 Days	Day 218	Day 220
Application of Nutrients, Microbes, and Water	7 Days	Day 221	Day 227
Demobilization	7 Days	Day 228	Day 234
End of First Year Sampling	3 Days	Day 594	Day 596
End of Second Year Sampling	3 Days	Day 956	Day 958
Development of Closure Report	30 Days	Day 959	Day 988
Closure	0 Days	Day 988	Day 988
PROJECT DURATION	988 Days		

Alternative: Land Spreading

Estimated Project Duration

Sites:
Diesel Spill (SS05)
Gasoline Storage Area (ST08)
Old Sewage Area Petroleum Spill (SS11)

Start Date: Day 1
Media: Gravel

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Landspreading Plan	60 Days	Day 61	Day 120
Solid Waste Disposal Permit	60 Days	Day 61	Day 120
Mobilization	7 Days	Day 121	Day 127
Preliminary Sampling	3 Days	Day 128	Day 130
Landspreading and Application of Water	21 Days	Day 131	Day 151
Demobilization	7 Days	Day 152	Day 158
End of First Year Sampling and Reapplication of Water	10 Days	Day 518	Day 527
End of Second Year Sampling	3 Days	Day 887	Day 889
Development of Closure Report	30 Days	Day 890	Day 919
Closure	0 Days	Day 919	Day 919
PROJECT DURATION	919 Days		

Alternative: No Action
Estimated Project Duration

Sites:
Diesel Spill (SS05), Gasoline Storage
Area (ST08), Garage (SS10), Old
Sewage Area Petroleum Spill (SS11)

Start Date: Day 1
Medium: Tundra

Activity	Duration	Start Date	End Date
Development of Closure Report	30 Days	Day 1	Day 30
Closure	0 Days	Day 30	Day 30
PROJECT DURATION	30 Days		

Alternative: Institutional Controls and Monitoring
Estimated Project Duration

Sites:
Diesel Spill (SS05), Gasoline Storage
Area (ST08), Garage (SS10), Old
Sewage Area Petroleum Spill (SS11)

Start Date: Day 1
Medium: Tundra

Activity	Duration	Start Date	End Date
Development of Planning Documents	60 Days	Day 1	Day 60
Implementation of Institutional Controls	60 Days	Day 61	Day 120
Mobilization	2 Days	Day 121	Day 122
Preliminary Sampling	3 Days	Day 123	Day 125
Demobilization	2 Days	Day 126	Day 127
End of First Year Sampling	3 Days	Day 487	Day 489
End of Second Year Sampling	3 Days	Day 849	Day 851
Development of Closure Report	30 Days	Day 852	Day 881
Closure	0 Days	Day 881	Day 881
PROJECT DURATION	881 Days		

Alternative: Enhanced Bioremediation
Estimated Project Duration

Sites:
Diesel Spill (SS05), Gasoline Storage
Area (ST08), Garage (SS10), Old
Sewage Area Petroleum Spill (SS11)

Start Date: Day 1
Media: Tundra

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	3 Days	Day 218	Day 220
Application of Nutrients, Microbes, and Water	7 Days	Day 221	Day 227
Demobilization	7 Days	Day 228	Day 234
End of First Year Sampling	3 Days	Day 594	Day 596
End of Second Year Sampling	3 Days	Day 956	Day 958
Development of Closure Report	30 Days	Day 959	Day 988
Closure	0 Days	Day 988	Day 988
PROJECT DURATION	988 Days		

Alternative: No Action
Estimated Project Duration

Site:
Garage (SS10)

Start Date: Day 1
Medium: Soil beneath Garage

Activity	Duration	Start Date	End Date
Development of Closure Report	30 Days	Day 1	Day 30
Closure	0 Days	Day 30	Day 30
PROJECT DURATION	30 Days		

8

Alternative: Institutional Controls and Monitoring
Estimated Project Duration

Site:
Garage (SS10)

Start Date: Day 1
Medium: Soil beneath Garage

Activity	Duration	Start Date	End Date
Development of Planning Documents	60 Days	Day 1	Day 60
Implementation of Institutional Controls	60 Days	Day 61	Day 120
Mobilization	2 Days	Day 121	Day 122
Preliminary Sampling	3 Days	Day 123	Day 125
Demobilization	2 Days	Day 126	Day 127
End of First Year Sampling	3 Days	Day 487	Day 489
End of Second Year Sampling	3 Days	Day 849	Day 851
Development of Closure Report	30 Days	Day 852	Day 881
Closure	0 Days	Day 881	Day 881
PROJECT DURATION	881 Days		

Alternative: Containment
Estimated Project Duration

Site:
Garage (SS10)

Start Date: Day 1
Medium: Area Under Garage

Activity	Duration	Start Date	End Date
Development of Planning Documents	90 Days	Day 1	Day 90
Mobilization	7 Days	Day 91	Day 97
Installation of Containment	15 Days	Day 98	Day 112
Demobilization	7 Days	Day 113	Day 119
PROJECT DURATION	119 Days		

Alternative: Enhanced Bioremediation
Estimated Project Duration

Site:
Garage (SS10)

Start Date: Day 1
Media: Soil beneath Garage

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	3 Days	Day 218	Day 220
Application of Nutrients, Microbes, and Water	7 Days	Day 221	Day 227
Demobilization	7 Days	Day 228	Day 234
End of First Year Sampling	3 Days	Day 594	Day 596
End of Second Year Sampling	3 Days	Day 956	Day 958
Development of Closure Report	30 Days	Day 959	Day 988
Closure	0 Days	Day 988	Day 988
PROJECT DURATION	988 Days		

Alternative: Biosurfactants
Estimated Project Duration

Site:
Garage (SS10)

Start Date: Day 1
Media: Soil beneath Garage

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 61	Day 120
Mobilization	7 Days	Day 121	Day 127
Preliminary Sampling	3 Days	Day 128	Day 130
Application of Biosurfactant and Nutrients to Tank of Collected Water	7 Days	Day 131	Day 137
Final Sampling of Collected Water	1 Days	Day 497	Day 497
Demobilization	3 Day	Day 498	Day 500
Development of Closure Report	30 Days	Day 501	Day 530
Closure	0 Days	Day 530	Day 530
PROJECT DURATION	530 Days		

Alternative: Enhanced Bioremediation
Estimated Project Duration

Sites:
All sites

Start Date: Day 1
Media: All Media

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	7 Days	Day 218	Day 224
Application of Nutrients, Microbes, and Water	14 Days	Day 225	Day 238
Demobilization	7 Days	Day 239	Day 245
End of First Year Sampling	7 Days	Day 605	Day 611
End of Second Year Sampling	7 Days	Day 971	Day 977
Development of Closure Report	30 Days	Day 978	Day 1007
Closure	0 Days	Day 1007	Day 1007
PROJECT DURATION	1007 Days		

APPENDIX A

REFERENCES AND LIST OF ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASUREMENT

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LIST OF ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASUREMENT

ADEC	Alaska Department of Environmental Conservation
AFCEE	Air Force Center for Environmental Excellence
Air Force	United States Air Force
ARARs	Applicable or Relevant and Appropriate Requirements
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Chemical of Concern
CT&E	Commercial Testing and Engineering, Inc.
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DEW	Distant Early Warning
DOD	Department of Defense
DOT	Department of Transportation
DRO	Diesel Range Organics
DRPH	Diesel Range Petroleum Hydrocarbons
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
F&B	Friedman & Bruya, Inc.
FS	Feasibility Study
FWPCA	Federal Water Pollution Control Act
GC	Gas Chromatograph
GC/MS	Gas Chromatography/Mass Spectrometry
GRA	General Response Action
GRO	Gasoline Range Organics
GRPH	Gasoline Range Petroleum Hydrocarbons
HQ	Hazard Quotient
HVOC	Halogenated Volatile Organic Compound
ICP	Inductively Coupled Plasma
IDW	Investigation Derived Waste
IRP	Installation Restoration Program
LRR	Long Range Radar
MCL	Maximum Contaminant Level
MSL	Mean Sea Level
NCP	National Contingency Plan
NPL	National Priority List
PCBs	Polychlorinated Biphenyls
POL	Petroleum, Oils, and Lubricants
QA	Quality Assurance

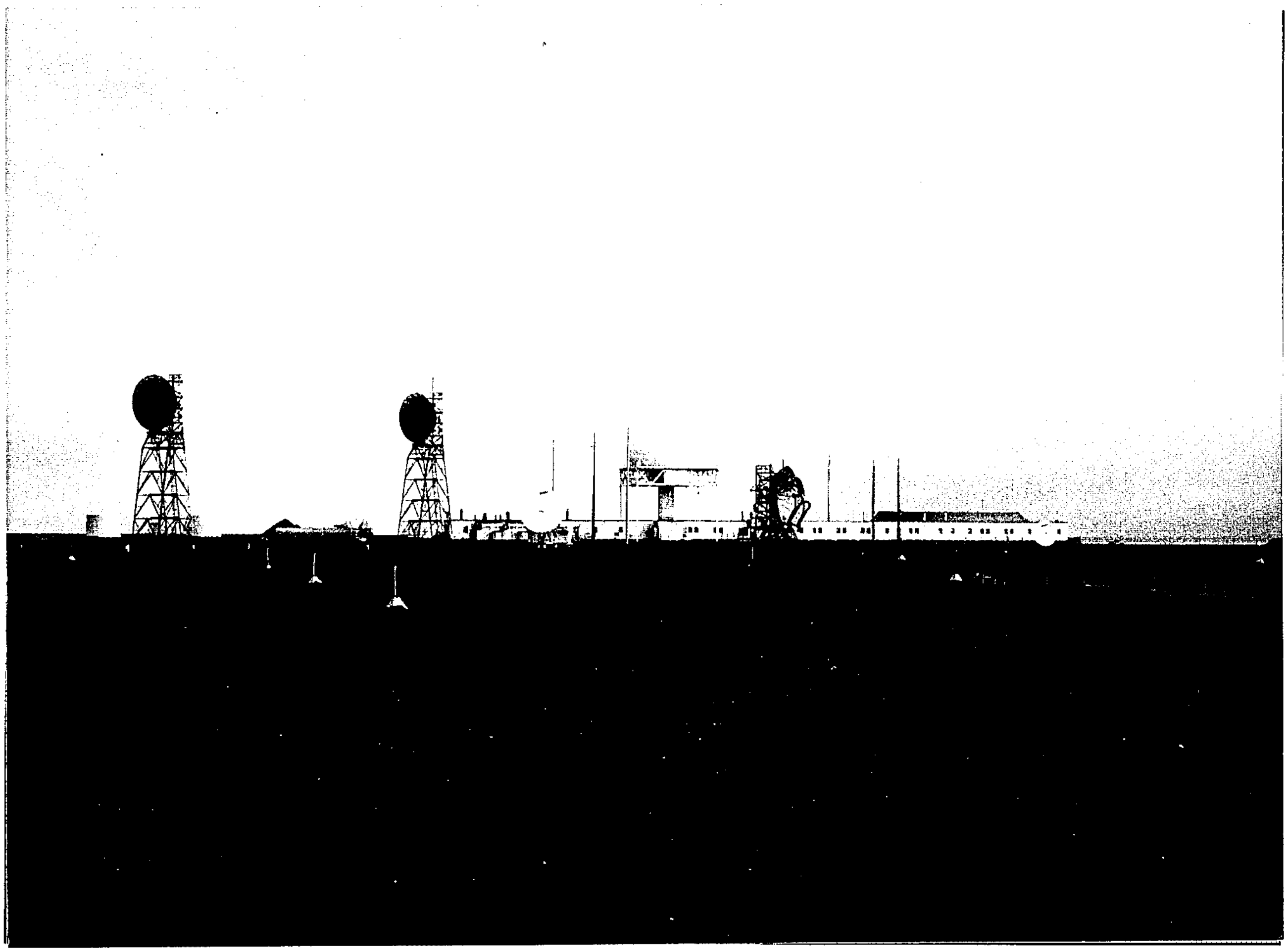
QAPjP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
RBSL	Risk-Based Screening Level
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RRPH	Residual Range Petroleum Hydrocarbon
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SOPs	Standard Operating Procedures
SRR	Short Range Radar
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TRV	Toxicity Reference Value
TSS	Total Suspended Solids
UCL	Upper Confidence Limit
VOC	Volatile Organic Compound

MEASUREMENTS

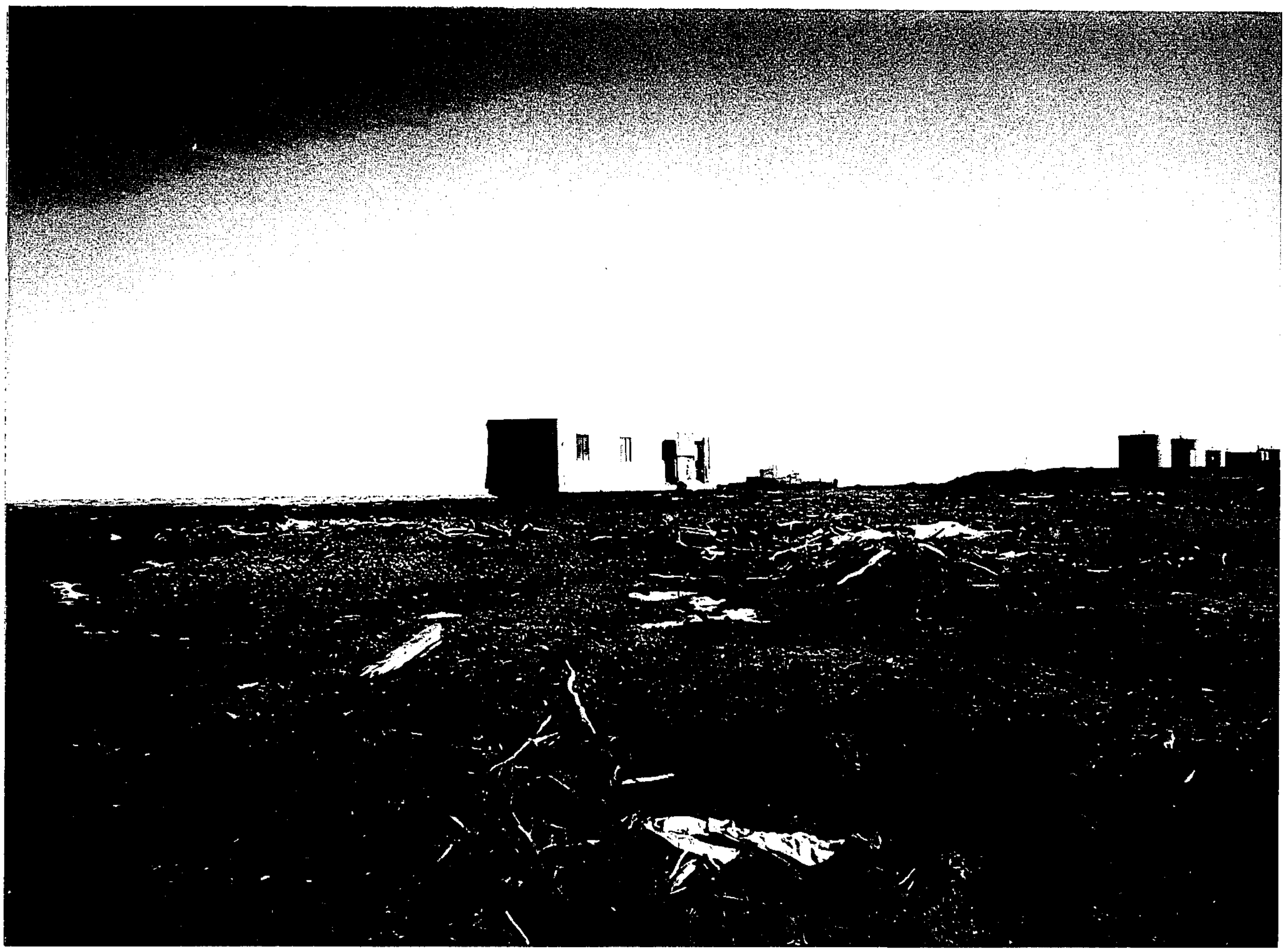
µg/L	micrograms per liter
mg/kg	miligrams per kilogram
ppm	parts per million

APPENDIX B

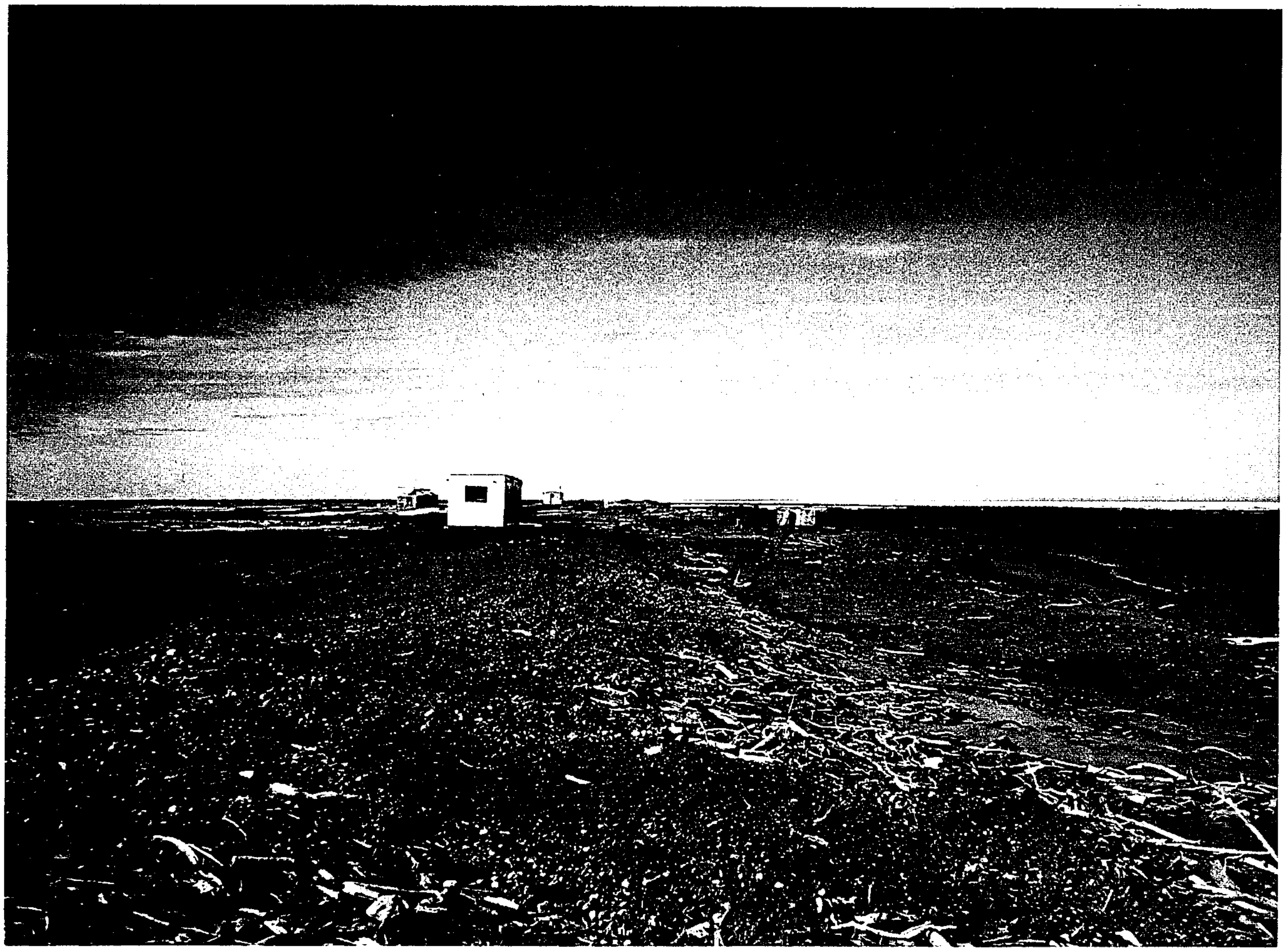
PHOTOGRAPHS OF THE OLIKTOK POINT RADAR INSTALLATION AND SITES



A view to the north of the Oliktok Point radar installation.

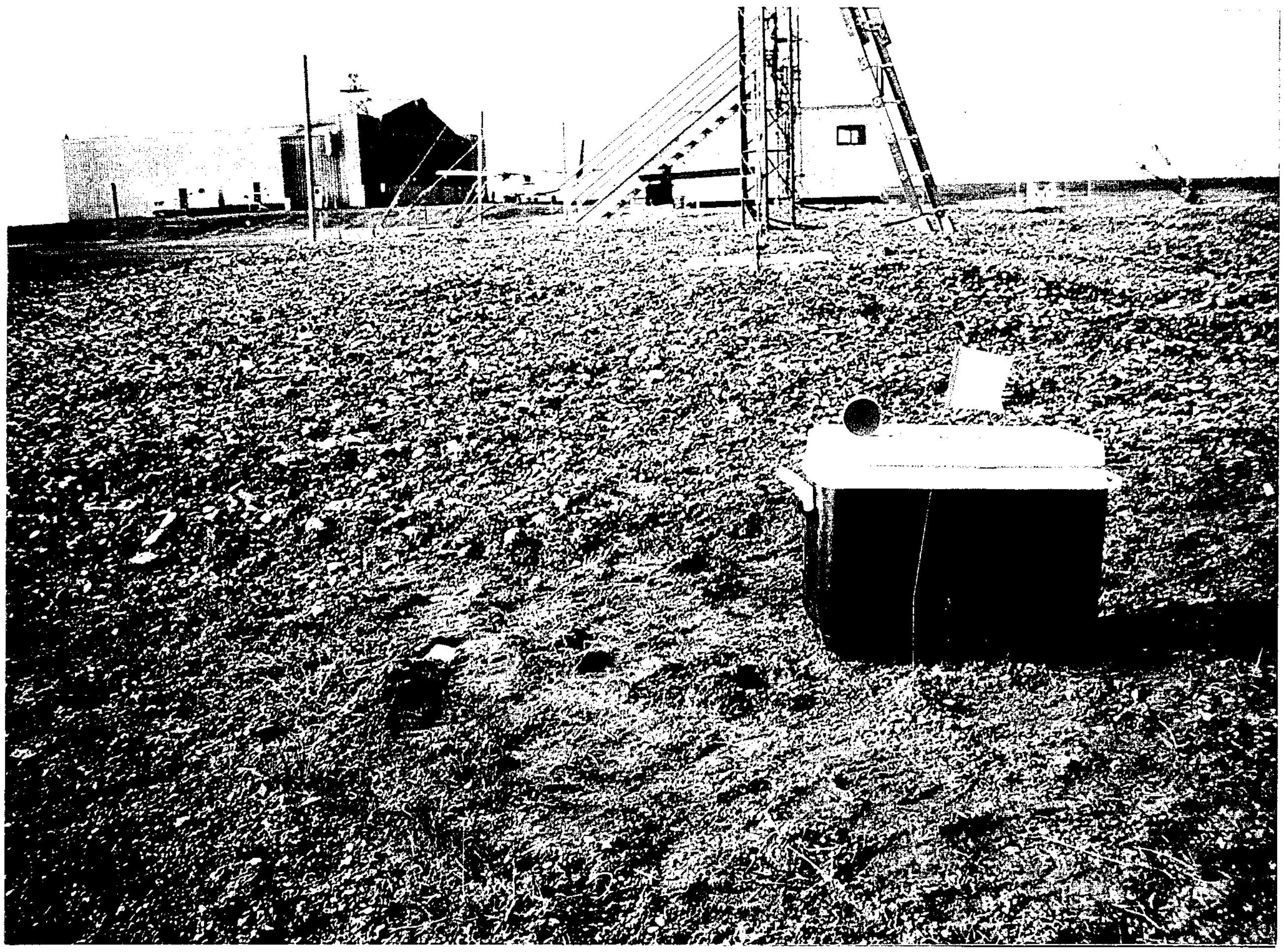


The Old Landfill (LF01) site is the location of the old station dump that received all wastes generated by the station, other than those that were incinerated, from 1956 to approximately 1978. This is a view to the northeast.



The Dump Site (LF02) site is located east of the Old Landfill (LF01) and north of the Dock Storage Area (ST03). This view is to the west.

This is a view to the southeast of the Dock Storage Area (ST03) site. Drums were removed from this site prior to 1987.

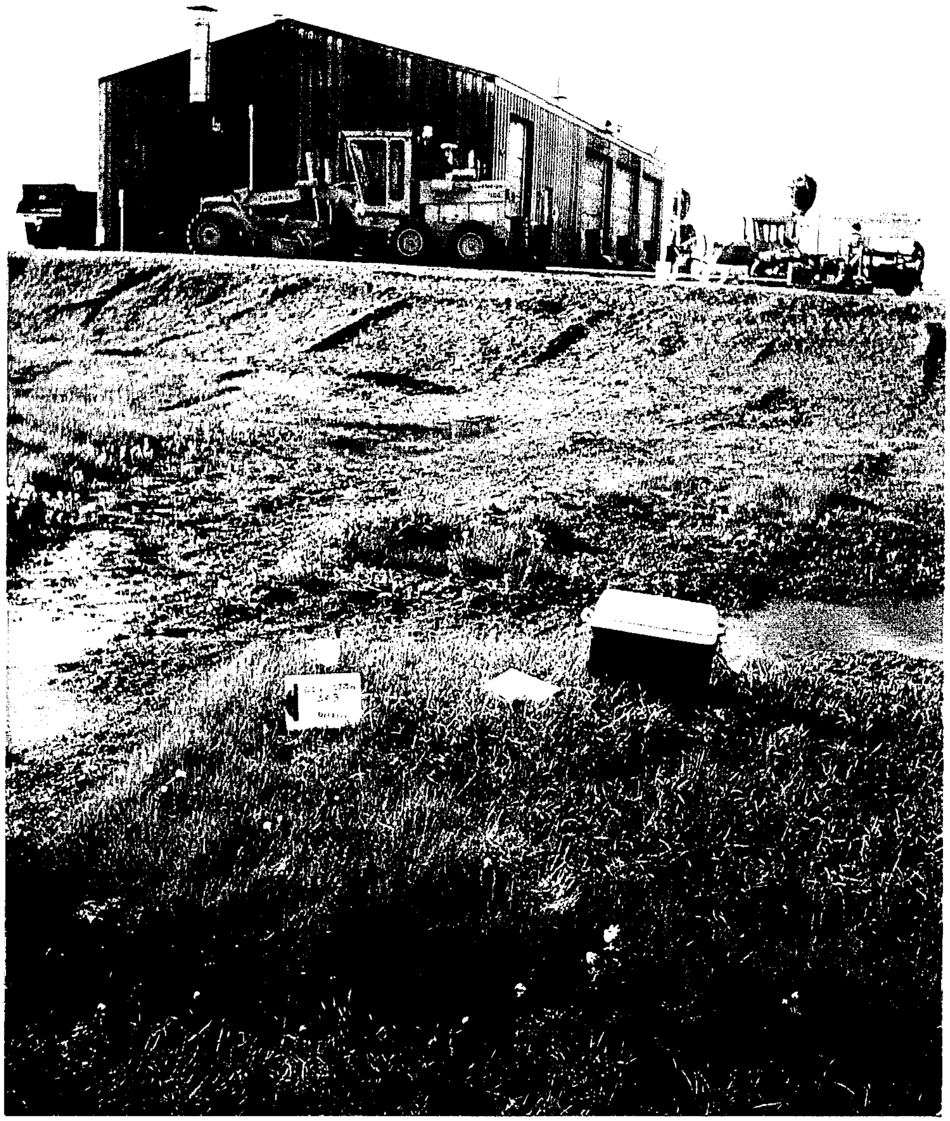


This is a view to the southwest of the POL Storage (ST04) site. The gravel pad area is presently a weather monitoring station. Drums were removed after 1987. The Diesel Spill (SS05) site is located in the upper left corner of the photo.

A view to the west of the Diesel Spill (SS05) site. The site is adjacent to the east side of the hangar.

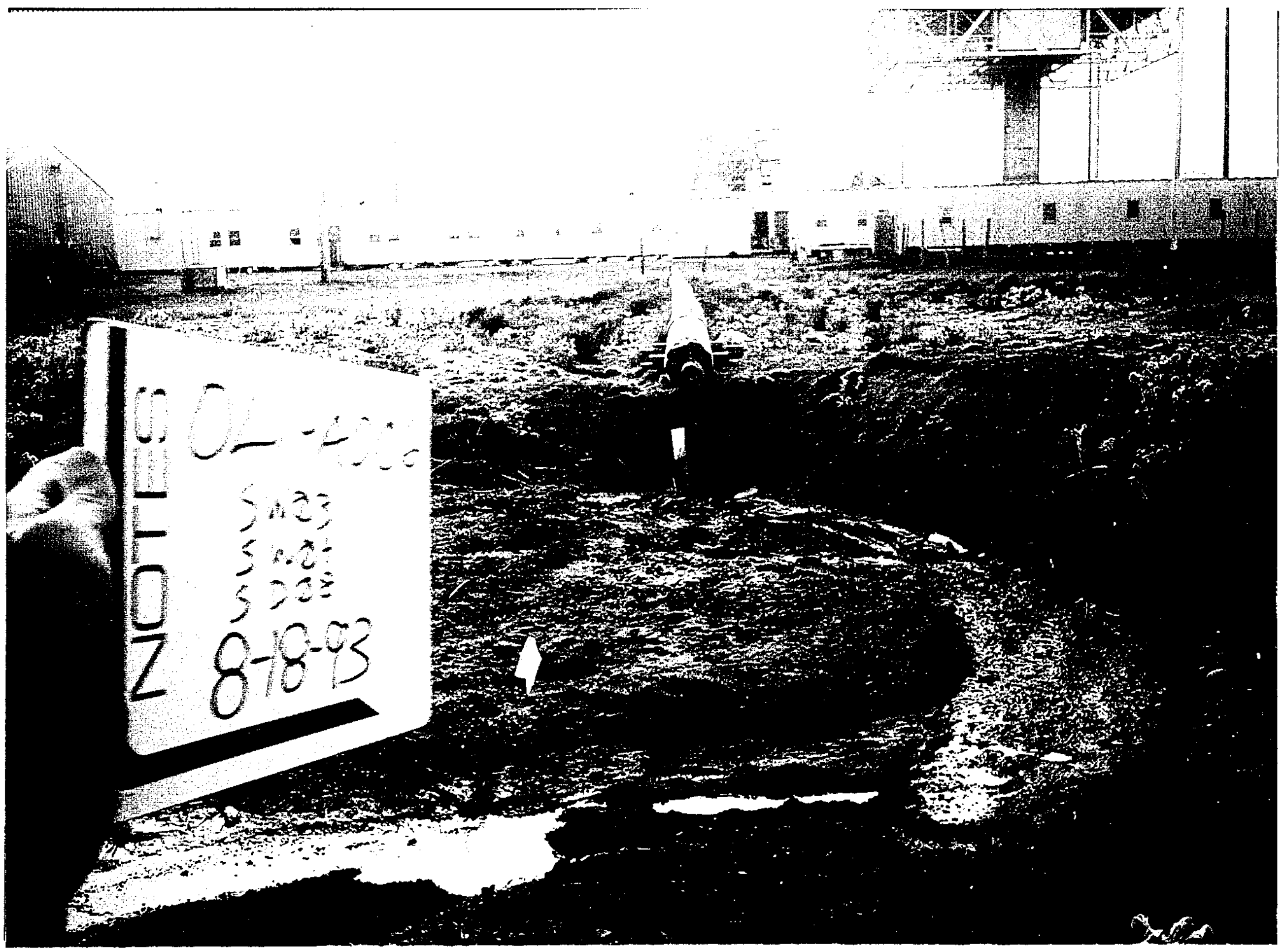
This is a view to the south of the Gasoline Storage Area (ST08) site. Two steel diesel storage tanks were formerly located on the gravel pad in front of the garage. The site extends out into the tundra.

This view is to the southwest of the Gasoline Storage Area (ST08) site. The gravel pad and Garage (SS10) site are located just to the left of this photo.



The Garage (SS10) site and the Gasoline Storage Area (ST08) site are adjacent. Samples were collected in the tundra in this photo for the Gasoline Storage Area (ST08) site; the Garage is located on the gravel pad.

This is a view to the west of the Garage (SS10) site.



The Old Sewage Area Petroleum Spill (SS11) is located north of the module train.
This is a view to the south of the inactive sewage outfall pipe.